# ACTA SOCIETATIS ZOOLOGICÆ BOHEMOSLOVACAE

LIV

4

ACADEMIA PRAHA

ISSN 0862-5247

Kčs 20,— 47 678

ACTA SOCIETATIS ZOOLOGICAE BOHEMOSLOVACAE
ročník LIV

Vydává Čs. společnost zoologická, Viničná 7, 128 44 Praha 2, v Academii, nakladatelství ČSAV, Vodičkova 40, 112 29 Praha 1. Tisknou Tiskařské závody, n. p. závod 5, Sámova 12, 101 46 Praha 10. — Rozšiřuje PNS. Informace o předplatném podá a objednávky přijímá každá administrace PNS, pošta, doručovatel a PNS-ÚED Praha, ACT, Kafkova 19, 160 00 Praha 6, PNS-ÚED Praha, závod 02, Obránců míru č. 2, 656 07 Brno, PNS-ÚED Praha, závod 03, Gottwaldova 206, 709 90 Ostrava 9. Objednávky do zahraničí vyřizuje PNS—ústřední expedice a dovoz tisku Praha, administrace vývozu tisku, Kovpakova 26, 160 00 Praha 6. Návštěvní dny: středa 7,00—15,00 hodin, pátek 7,00—13,00 hodin. Cena jednoho výtisku Kčs 20,—, roční předplatné (4 čísla ročně) Kčs 80,—. (Tyto ceny jsou platné pouze pro Československo.)

Distribution rights in the western countries: Kubon & Sagner, P. O. Box 34 01 08 D-8000 München 34, GFR. Annual subscription: Vol. 54, 1990, (4 issues, DM 124,— excl. postage).

This number issued on December 20, 1990

© Academia, Praha 1990

***ACTA SOCIETATIS ZOOLOGICAE BOHEMOSLOVACAE**[*]*

Roč. Tom. 54 Čís. No. 4 Prosinec December 1990

*Acta Soc. Zool. Bohemoslov.* ISSN 0862—5247

Official publication of the Czechoslovak Zoological Society

Editorial Board: K. Hůrka (Editor), K. Absolon (Executive Editor), V. Baruš, J. Buchar, J Hrbáček, D Matis, V Novák, O. Oliva, J Lom, B Ryšavý, F. Sládeček, Z. Veselovský, J. Vojtek

# CONTENTS

**Divoký V., Půlpán J., Rébl K.:** Harpalus (Harpalus) cisteloides hurkai subsp. n. aus der Tschechoslowakei (Coleoptera, Carabidae) . . . . . 241
**Hanel L.:** The length and weight growth changes of the common perch (Perca fluviatilis, Pisces, Perciformes) from the Slapy reservoir (Central Bohemia) . . . . . . . . . . . . . . . . . . . . 246
**Hubálek Z.:** Predicting the time of morning departure from winter communal roosts in *Corvus frugileus* (Aves: Passeriformes) . . . . . . . 259
**Moravec F., Sey O.:** Some nematode parasites of frogs from Papua New Guinea and Australia . . . . . . . . . . . . . . . 263
**Scholz T., Ergens R.:** Cestodes of fishes from Mongolia . . . . . 285
**Šorič V.:** *Salmonids in the Ohrid-Drim-Skadar system* . . . . . 305
**Review** . . . . . . . . . . . . . . . . . . 319

---

[*] A continuation of the journal **Věstník československé Společnosti zoologické**

*Acta Soc. Zool. Bohemoslov.*, **54**: 241—245, 199
ISSN 0862—524

# HARPALUS (HARPALUS) CISTELOIDES HURKAI SUBSP. N. AUS DER TSCHECHOSLOWAKEI (COLEOPTERA, CARABIDAE)

Vladimír DIVOKÝ[1], Jan PULPÁN[2] und Karel RÉBL[3]

Lehrstuhl der Zoologie und Anthropologie der Palacký Universität, třída Svobody 26,
CS - 771 46 Olomouc[1]; Falťanova 553/19, CS - 149 00 Praha[2]; Žižkovo nám. 976,
CS - 271 01 Nové Strašecí[3]

Abstract *Harpalus (Harpalus) cisteloides hurkai* subsp. n. is described from the České středohoří Mts., Czechoslovakia; differential character states are illustrated. The taxonomic and zoogeographical problems of the *H. cisteloides*-group are discused.

Seit 1980 werden in einer beschränkten Lokalität von Steppencharakter in kleinem Vulkan-Gebirge *České středohoří (Tschechisches Mittelgebirge*, Nordböhmen) Vertreter der *Harpalus cisteloides*-Gruppe gefunden. Es handelt sich um Exemplare einer neuen Subspezies der polytypischen Art *Harpalus cisteloides* Motschulski.

Wir danken Herrn B. M. Katajev aus dem Zoologischen Institut der Akademie der Wissenschaften in Leningrad, USSR, für die Untersuchung des Typenmaterials aus der Tschitscherinschen Sammlung und für seine nützliche briefliche Angaben. Ebenso herzlich danken wir Herrn V. P. Pervakov aus der Universität in Simferopol, USSR, für wesentliche Auskünfte über die studierte Gruppe. Unser Dank gilt auch Herrn Dr. R. Kubínek aus der Naturwissenschaftlichen Fakultät der Palacký Universität in Olomouc, ČSFR, für die Anfertigung der REM-Photos und Herrn Dr. J. Jelínek fur die Ausleihe des Materials aus den Sammlungen der Entomologischen Abteilung des Nationalmuseums in Praha. Wir danken Herrn D. W. Wrase (Berlin, BRD) für die Sprachenkorrektur der Handschrift.

Methodik. Bei der Anfertigung der mikroskopischen Dauerpräparate der sklerotisierten Teile der Kopulationsorgane wurde die Methode von Majer (1982) modifiziert. Als Medium wurde anstatt Gelatine-Chloralhydrat Kanadabalsam nach Entwasserung der Objekte in Dioxan benutzt. Beim Zeichnen der Genitalien wurde auf ihre konstante Lage geachtet. Die Mikroskulptur der Flügeldecken wurde durch das Rasterelektronenmikroskop Tesla BS 300 untersucht und photographiert. Die Objekte wurden getrocknet photographiert, nach Reinigung und Entfettung, ohne dass eine leitende Schicht aufgetragt wurde, was allerdings eine niedrigere technische Qualitat der Bilder verursachte (es entstanden dunkle Artefakte auf der Mikrophotos).

## TAXONOMISCHER TEIL

Mlynář (1974, 1979) und Katajev (1989 und briefliche Mitteilung) reihen in die *H. cisteloides*-Gruppe folgende Taxa: *H. cisteloides cisteloides* Motschulski, *H. schouberti* Tschitscherin, *H. aequicollis* Motschulski und *H. heyrovskyi* Jedlička. Die Zugehörigkeit zur Gruppe ist besonders bedingt durch die Ähnlichkei der Form sowie der Struktur des Aedeagus-Innensacks. Als ein neues Taxon dieser Gruppe wird *H. cisteloides hurkai* subsp. n. beschrieben und abgebildet.

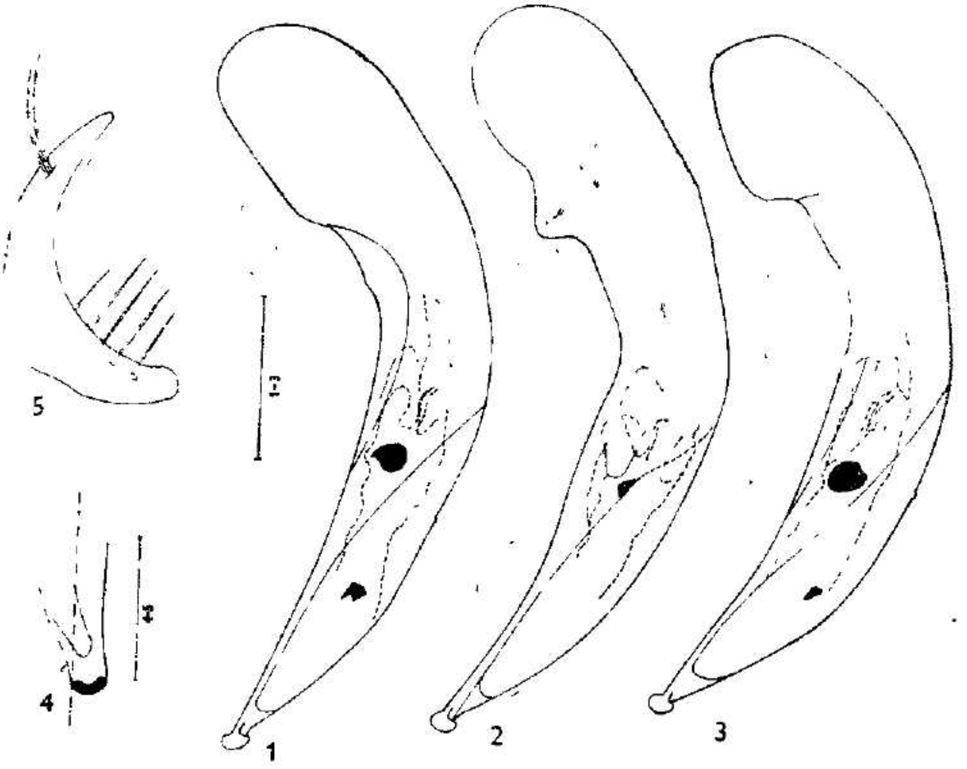


**Abb. 1—5.** Genitalien von ***Harpalus cisteloides*** Mots. 1—3 Aedeagus, linke Lateralansicht: 1 — *H. c. cisteloides* Mots., Fergana, Turkestan, 2 — *H. c. schouberti* Tschit., Cchra-Ckcharo 2500 m, Gruzien, 3 — *H. c. hurkai* subsp. n., České středohoří, ČSFR, Holotypus; 4—5 *H. c. hurkai* subsp. n., České středohoří, ČSFR: 4 — Distalteil von Aedeagus dorsal (Holotypus), 5 — Stylus des Weibchens dorsal (Paratypus). Masstab = 1 mm.

### *Harpalus cisteloides cisteloides* Motschulski, 1844

(Abb. 1, 7)*

Originalbeschreibung: *Harpalus cisteloides* Motschulski, 1844; Lectotypus, Zoologisches Museum der Moskauer Universität, design. von Shilenkov 1976 (nach Mlynar, 1979: 91); typische Lokalität: Semipalatinsk.

Synonymie: ***Harpalus maurus*** Tschitscherin, 1897; Lectotypus, Zoologisches Institut der Akademie in Leningrad, design. von Mlynar (1979: 91); typische Lokalität: Turkestan.

Diagnosis. Aedeagus auf der Ventralseite wenig gebogen, dorsal leicht bauchig, mit schmalerer Spitze (Abb. 1). Die Männchen schwach glänzend, mit fast flachen Feldern der isodiametrischen Mikroskulptur der Flügeldecken (Abb. 7).

Verbreitung. Westasiatisch-sibirische Art (Csiki, 1932; Mlynar, 1979). Turin (1981) führt die Art für Europa nicht an. Nach Katajev (briefliche Mitteilung) kommt sie jedoch auch im europäischen Teil der Sowjetunion vor; die westlichste Fundstelle liegt im Kuibyshew-Gebiet (Buguruslan--Rajon).

---

*Die Abb. 7 ist am Ende des Hefts zu finden

**Material: TRKST. JAGNOB Varsaut, H. maurus Tschit. comp. cum typus Kryzhanovskij det 69, 1 ♂; Fergana Turkest., 927, 1 ♂; Fergana Turkest., Harpalus maurus Tschit., 1 ♂; USSR KAZACHSTAN Aksaj 30. 5. 1974 Alma-Ata env. Kr. Pospíšil lgt., H. maurus Tschit (ssp. ?) Z. Mlynář det. 1976, 1 ♂; Čeljabinsk Sib. occ — Smolino Dr. Jureček 1917, 1 ♀.**

### *Harpalus cisteloides hurkai* subsp. **n.**

(Abb. 3, 4, 5, 6, 8)*

Derivatio nominis: Herrn Doz. Dr. Karel Hůrka, DrSc., Karls-Universität Praha, einem hervorragenden tschechoslowakischen Entomologen, der sich auch für die Untersuchung der Familie Carabidae sehr verdient gemachthat, gewidmet.

Diagnosis. Aedeagus auf der Ventralseite mehr gebogen, konkav, auf der Dorsalseite stärker bauchig, mit breiterer Spitze (Abb. 3). Die Felder der isodiametrischen Mikroskulptur der Flügeldecken bei den Männchen leicht gewölbt (Abb. 8), die Flügeldecken damit weniger glänzend.

Beschreibung (Holotypus, ♂, Abb. 6): Schwarz. Ausser dem glänzenden Kopf leicht matt. Kopf glatt. Halsschild flach, quadratisch, mit seichten, unpunktierten Basaleindrücken. Halsschildseiten subparallel, Seitenrandkehle nach hinten verbreitet; Hinterecken rechtwinklig, kaum abgerundet, Vorderecken abgerundet und leicht vorragend. Maximalbreite des Halsschilds dicht hinter der Mitte. zu den Hinterecken sind die Seiten fast parallel. Die Mittelfurche seicht. Halsschildbasis in der Mitte leicht konvex, kahl. Flügeldecken fast flach, nicht gewölbt, mit lang parallelen Seiten; Skutellarstreifen sehr lang, Flügeldeckenstreifen seicht; die Mikroskulptur zeigt die Abb. 8. Skutellarborstenpunkt und Dorsalborstenpunkt, sowie Apikalpunkte im 7. und einerseits auch im 5. Zwischenraum vorhanden. Humeralzähnchen undeutlich. Vordertarsen braunrot. Mitteltarsen braun; 1. Fühlerglied rot, 2. und 3. Glied angedunkelt, übrige Glieder braun. 1. Glied der Maxillarpalpen sowie Ende des 3. Glieds rot, 2. Glied zu 2/3, 3. Glied zu 1/3 angedunkelt, übrige Teile braun, Labialpalpen rot. Die Flügel voll entwickelt. Aedeagus (Abb. 3, 4) mit 2 pigmentierten Skleriten im Innensack. Gesamtlänge: Flügeldeckenlänge = 1,61; Flügeldeckenlänge: Halsschildlänge = 1,63. Gesamtlänge = 10,0 mm.

Variabilität der Paratypen: Maxillarpalpen rot bis braun oder (1), 2. und 3. Glied in der Apikalhälfte angedunkelt. Fühler mit 1.—2. Glied rot, 2.—3. (5.) Glied getrübt bis schwarzbraun, die übrigen Glieder angedunkelt oder rotbraun bis rot. Vordertarsen dorsal braun bis braunrot, Mitteltarsen braun, Hintertarsen pechbraun, mit dem letzten Glied braun bis hellbraun. Flügeldecken der Weibchen matter als bei den Männchen, bei einigen Exemplaren seidenmatt, Apikalpunkte im 7. und einerseits, sowie beiderseits im 7. und 5. Flügeldeckenzwischenraum. Gesamtlänge: Flügeldeckenlänge = 1,62—1,68 (Ø 1,65); Flügeldeckenlänge: Halsschildlänge = 1,47—1,65 (Ø 1,54). Gesamtlänge bei den Männchen = 9.1—10,8 (Ø von 23 Ex. 10,0) mm, bei den Weibchen = 9,2—10,5 (Ø von 7 Ex. 10,04) mm.

Verbreitung. Tschechoslowakei, Gebirge České středohoří, bisher nur auf zwei benachbarten Bergen: Dlouhý vrch (29 Ex.) und Milá (1 Ex.).

---

***Die Abb. 6 und 8 sind am Ende des Hefts zu finden**

Typische Lokalität: Berg Dlouhý vrch bei der Gemeinde Bělušice, zusammen mit *Harpalus tardus* (Panzer).

**Untersuchtes Material. Holotypus: Bohemia b. Č. Středohoří P. Moravec leg. Dlouhý v. (Bělušice) 7. 8. 82, ♂, in der Pulpán-Sammlung (Praha). Paratypen (22 ♂♂, 7 ♀♀): České středohoří — kopec Milá: 5. 1980, Pulpán lgt., 1 ♂; České středohoří — Dlouhý vrch p. Bělušice: 21 ♂♂, 7 ♀♀ (28. 3. 1981, Rébl lgt., 1 ♂, 1 ♀; 19. 4. 1981, Rébl lgt., 1 ♂; 7. 6. 1981, Wachtl lgt., 2 ♂♂; 13. 6. 1981, Rébl lgt., 1 ♀, Wachtl lgt., 1 ♂, 2 ♀♀; 28. 3. 1982, Rébl lgt., 1 ♂; 5. 1982, Skoupý lgt., 1 ♀; 1 8 1982, Moravec lgt., 5 ♂♂; 21. 5. 1983, Bulirsch lgt., 2 ♂♂, Moravec lgt., 3 ♂♂, Wrase lgt., 1 ♂, 1 ♀; 28. 5. 1983, Skoupý lgt., 2 ♂♂; 5. 1985, Pulpán lgt., 1 ♂; 3. 10. 1985, Wrase lgt., 1♂, 1 ♀).**

## DISKUSSION

*H. cisteloides* stellt nach Mlynar (1979) die westliche Vikariantart des ostasiatischen *H. aequicollis* Motschulski, 1844 dar. Im Rahmen der polytypischen Art *H. cisteloides* weist die "Form" *schouberti* Tschitscherin, 1898 eine unklare Position auf (typische Lokalität: Daghestan). Mlynar (1979) bezieht auf dieses Taxon die kaukasische Rasse von *H. cisteloides*. Diagnostische Merkmale auf dem Halsschild und den Flügeldecken, die sowohl von Tschitscherin (1898), als auch von Mlynar (1979) angegeben wurden, betreffen nicht die konstanten Unterschiede zwischen beiden Taxa *cisteloides* und *schouberti*. Die von uns untersuchten Männchen vom Kaukasus und den Gebirgen Armeniens (Georgian SSR mer Cchra-Ckcharo pass 2500 m 17.—19. 6 71 Z. & J. Novotný lgt, H. maurus Tschit. (= schouberti Tschit.) Z. Mlynář det. 1975 cum HOLOTYP H. schouberti comp., 1 ♂; Georgian SSR mer. Cchra-Ckcharo pass 2500 m 17.—19. 6. 71 Z. & J. Novotný lgt., 2 ♂♂; Bakuriany Rossia, maurus Tsch. det. Ing. Jedlička, 1 ♂) besitzen einen auf der Ventralseite gebogenen Aedeagus, mit einem einzigen Pigmentkörperchen im Innensack (Abb. 2). Der Holotypus von *H. schouberti* Tschit. hat jedoch, sowie alle Männchen der Nominatunterart *H. c. cisteloides*, 2 Pigmentkörperchen im Innensack (Katajev. briefliche Mitteilung). Eine Festlegung der taxonomischen Position der "Form" *schouberti* Tschit. wird erst nach der Untersuchung der Populationen, die zwischen dem Kaukasus und dem Territorium nördlich des Kaspi-Sees leben, möglich.

Der Charakter des Aedeagus-Innensacks der Männchen von Ceské středohoří ist identisch (im Rahmen der Variabilität) mit dem der Mannchen aus Mittelasien. Die Form des Aedeagus, der Krümmung der Ventral- und Dorsalseite (in linker Lateralansicht). ist etwas veränderlich. Die Merkmale für die Unterscheidung der neuen Unterart von *H. c. cisteloides* sind jedoch immer deutlich. In Dorsalansicht ist die Krümmung des Distalteils des Aedeagus bei allen drei Taxa (*cisteloides, schouberti, hurkai*) ohne konstante Differenz (Abb. 4) Die Styli der Weibchen (Abb. 5) sind sehr variabel und konnten nicht für die subspezifische Trennung benutzt werden. Die angegebenen diagnostischen Merkmale der Population von České středohoří werden in der Taxonomie der Gattung *Harpalus* als subspezifische betrachtet (Mlynář, 1974, 1979).

Die bisher bekannte westlichste Population der Art *H. cisteloides* in Osteuropa (USSR, Kuibyshew-Gebiet) lebt mehr als 2000 km von der Lokalität in Böhmen entfernt. Wenn man die allopatrische Population im České středohoří als eine Unterart betrachtet, muss man das Vorhandensein von Verbindungspopulationen auf ähnlichen Standorten in Richtung der Ausbreitung, also im pannonischen Distrikt der Eurosibirischen Provinz der Steppen voraussetzen

Es erscheint merkwürdig, dass eine so grosse Lücke zwischen beiden Populationen besteht, da doch die böhmischen Tiere voll geflügelt, wärme- und trockenheits liebend sind. Eine klare Erklärung für die Entstehung der böhmischen Rasse kann man gegenwärtig nicht finden. Es ist unwahrscheinlich, dass sie das rauhe Klima der Glaziale, besonders was die Temperatur betrifft, überleben konnte. Sollten sich Verbindungspopulationen in Richtung der Ausbreitung finden, könnte die Unterart aus der Periode des günstigen Klimas im Boreal stammen.

## LITERATUR

Csiki E. 1932: Harpalinae VI. In Junk W. & Schenkling S.: Coleopterorum Catalogus, 3, 121. Pp. 1023—1278, Berlin.

Kataev B. M. 1989: Novye dannye o žuželicach rodov Pangus i Harpalus (Coleoptera, Carabidae) Mongolii s reviziej rjada palearktičeskich grupp. Tr. Zool. Inst. AN SSSR, *Nasekomye Mongolii*, 10: 188—278, Nauka Leningrad.

Majer K. 1982: Species of the Aplocnemus of Middle Europe (Col., Melyridae). *Dtsch. Ent. Z., N. F.*, 29: 421—445.

Mlynář Z. 1974: Die Harpalus-Arten aus der Mongolei. Ergebnisse der zoologischen Forschungen von Dr. Z. Kaszab in der Mongolei (Coleoptera, Carabidae). *Entom. Abh. Mus. Tierk. Dresden*, 40: 1—63.

Mlynar Z. 1979: Beitrag zur Kenntnis der osteuropäischen und sibirischen Harpalus-Arten (Col., Carabidae). *Koleopter. Rdsch.*, 54: 73—111.

Motschulski V. 1844: Insectes de la Sibérie rapportés d'un Voyage fait en 1839 et 1840. *Mém. Prés. Acad. Sci. St. Pétersbourg*, 5, 274 + XV pp.

Tschitschérine T. 1897: Carabiques du Turkestan russe. *L'Abeille*, 29: 76—80.

Tschitschérine T. 1898: Carabiques noveaux ou peu connus II. *L'Abeille*, 29: 93—114

Turin H. 1981: Provisional checklist of the European ground-beetles (Coleoptera: Cicindelidae & Carabidae). *Monogr. Nederl. Ent. Veren.*, 9, 251 pp., Amsterdam.

Eingegangen am 4. November 1989; angenommen am 7. Juni 1990

*Acta Soc. Zool. Bohemoslov.*, **54:** 246—258, 1990
ISSN 0862—5247

# THE LENGTH AND WEIGHT GROWTH CHANGES OF THE COMMON PERCH (PERCA FLUVIATILIS, PISCES PERCIFORMES) FROM THE SLAPY RESERVOIR (CENTRAL BOHEMIA)

Lubomír HANEL

Management of Protected Landscape Area Blaník, CS - 257 06 Louňovice 8

**Abstract.** The data concerning the length and weight growth of the perch (*Perca fluviatilis*) in the Slapy reservoir 1985—87 using 3 512 specimens at the 0 age group to 8 age group are presented. Equations after von Bertalanffy, length-weight relationship and Fulton's coefficient were calculated. Differences between both sexes are discussed. The growth rate of the perch from the above mentioned locality is compared within the period 1957—87, besides the differences in the growth in various stagnant waters in Czechoslovakia and abroad are given.

## INTRODUCTION

The perch,, *Perca fluviatilis* (Linnaeus, 1758) belongs to the most common fish species of Czechoslovak rivers, brooks, artificial ponds and reservoirs (riverine lakes). The length growth of the perch in Czechoslovakia was up to the present time studied by several authors, e.g. Kříženecká-Pulánková (1952), Frank (1958, 1960, 1967), Hnatevič (1960), Lohniský (1960 a, 1967), Vostradovský (1962), Kirka (1964), Holčík (1969 a, b), Švátora (1974), Pivnička (1982), Lojkásek (1986), Hanel (1987). Outside Czechoslovakia, data are known e.g. from Finland (Segerstrale, 1933, see Lohniský, 1960; Valle, 1944), from Sweden (Alm, 1946), from Scotland (Shafi and Maitland, 1971), Holland (Deedler, 1950), from Germany (Röped, 1936), from USSR (Domračev, 1926; Tjurin, 1935, see Berg, 1949; Šentjakova, 1959; Gundrizer et al., 1981; Kupčinskaja, 1987).

The growth of the perch in the Slapy reservoir was studied more than to quarter of the century ago by Frank (1958, 1959, 1960), Lohniský (1960, a) and Čihař (1961). In the present study the comparison of the growth with own values is based on new samples from 1985—87. This made possible to make some conclusion concerning the length and weight growth potencies of the perch in Czechoslovakia and neighbouring countries.

The Slapy reservoir is situated on the river Vltava at a height between 220——271 m above sea level. It was created in the years 1949—55. The reservoir area is 1392 ha, the total water volume of $2.693.10^8$ m$^3$, the permanent volume of $6.8 \,.\, 10^7$ m $^3$, the average inflow $84.5$ m$^3 \,.\, s^{-1}$, the water retention time 38.5 days Concerning water chemism during 1985—87 the following values were found: the temperature of water 0.2—21.9 (ave. 10.9 °C), pH = 6.7—9.3 (ave 7.4), total P 12.7—94.5 (ave. 46.9 mg . $l^{-1}$), total N 2.0—8.5 (ave. 3.7 mg . $l^{-1}$), the transparency 1.1—4.8 (ave. 2.8 m), more details summarized by Hanel (1989). This reservoir is employed also for human recreation, for bathing, swimming, yachting, vindsurfing and canoeing. Fishing and angling in the Slapy reservoir is also possible. The roach (*Rutilus rutilus*), the perch (*Perca fluviatilis*) and the ruffe (*Gymnocephalus cernuus*) were most abundant fish species in samples obetained by seine nets during the period of 1985—87. In these samples the perch formed 20 % of the total biomass of fishes and 23 % of their total abundance on the average. During the period of 1961—86 the decrease of average weight was found in the angled perch, while the number of annually angled specimens was increasing. The total biomass of annually angled fish of various species was relatively very low and in 1961—86 it has fluctuated between 10—26 kg . ha$^{-1}$ (ave. 16 kg . ha$^{-1}$). The examined reservoir belongs to known localities, where catches of large-size fishes, e.g. the pike (*Eosx lucius*), the carp (*Cyprinus carpio*) and the wels (*Silurus glanis*) were often noted. Furtner literary sources concerning the Slapy reservoir see Hanel, Čihař (1984).

## MATERIAL AND METHODS

Specimens for the study were seined in the Slapy reservoir in localities Stará Živohošť (May, 18, 1985, n = 32), Nová Živohošť (May, 18, 1965, n = 36; October, 12, 1985, n = 370, June, 21, 1986, n = 279; October, 11, 1986, n = 322; May 16, 1987, n = 398), the young of the year were seined at the locality Psané skály (August, 12, 1985, n = 140; June, 30, 1986, n = 90; August, 4, 1986, n = 914; July, 6, 1987, n = 643) and Nová Živohošť (August, 22.—28., 1987 ,n = 288).

The fishes were caught during the day and especially at night. For netting two seine nets were used, the first being 70 m long, 7 m deep, mesh size 3 × 3 cm, 1.2 × 1.2 cm and 0.7 × 0.7 cm and the second 10 m long, 1.25 m deep, with meshes of 0.1 × 0.1 cm. In all specimens of the perch, the length of the body (BL) and total length (TL) in mm and the weight (in g) were determined. The sex was ascertained using dissection for the scale structure by the use of the projecting apparatus "Documator Lesegerät DL II", using the 17.5 times magnification. 5—10 selected scales were taken below the lateral line behind the end of the left pectoral fin. From collected scales only the one with the clearest annuli was studied. The body-scale relationship was found as linear, and therefore the method after R. Lee (1920) was used (see Novák, 1982) with the correction of 16 mm (Lohniský, 1960) for the back calculation of the body length in the individual years of life. The Fulton's coefficient (= conditional index), the suitable parameter for the study of the fish growth (Geršanovič, Markevič, Dergaleva, 1984) was calculated using the formula:

$$K_F = \frac{W \,.\, 10^4}{L^3}$$

where W is the total weight of captured specimens (in g) and L is their body length (in mm). The length-weight relationship was performed following the method of Rounsefell and Everhart (1960). The index of production (Pivnička, 1972) was used for the comparison of weight and growth within various reservoirs. The phenomenon of R. Lee was analyzed by the use of the method described by Hanel (1982). The length growth was compared using the formula of growth characteristics:

$$C_{lh} = \frac{\log l_n - \log l_{n-1}}{0.4343} \,.\, l_{n-1}$$

where, e.g., the index $C_{lh(2-4)}$ signifies the sum of this parameter in the fish age from 2 up to 4.

Table 1. Body length of young of the year of the perch from the Slapy reservoir

| Date of the capture | No. of specimens | Locality | Ranges of the body length (mm) | Avo. | s | $s_{\bar{x}}$ |
|---|---|---|---|---|---|---|
| August 8, 1985 | 140 | Psané skály | 30.8–47.8 | 37.2 | 3.6862 | 0.3115 |
| June 30, 1986 | 90 | Psané skály | 18.5–33.3 | 27.1 | 3.4003 | 0.3584 |
| August 4, 1986 | 914 | Psané skály | 26.9–54.5 | 41.9 | 4.2531 | 0.1407 |
| July 6, 1987 | 8 | Psané skály | 25.0–33.0 | 28.8 | 2.8276 | 0.9997 |
| July 6, 1987 | 635 | Psané skály (the esturary of the brook Mastník) | 22.0–33.0 | 27.3 | 1.8440 | 0.0732 |
| August 22–28, 1987 | 288 | Nová Živohošť | 30.0–68.0 | 52.7 | 5.6256 | 0.3315 |

Table 2. Average length growth of the perch in the Slapy reservoir

| Locality | Author | n | $l_1$ | $l_2$ | $l_3$ | $l_4$ | $l_5$ | $l_6$ | $l_7$ | $l_8$ | $l_9$ | $l_{10}$ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Slapy res. 1957 | Lohniský (1960) | 40♀♀ | 69 | 105 | 137 | | | | | | | |
| Slapy res. 1957 | Lohniský (1966) | 17♂♂ | 68 | 99 | 144 | | | | | | | |
| Slapy res. 1957 | Frank (1960) | | 64 | 100 | 132 | 167 | 205 | 239 | 264 | 300 | | |
| Bučily, 1957 | Lohniský (1960) | 73 | 67 | 100 | 135 | 156 | 203 | 236 | 259 | 299 | | |
| Živohošť, 1958 | Lohniský (1960) | 169 | 73 | 115 | 145 | 166 | 209 | 247 | 230 | 302 | | |
| Cholín | Frank (1959) | 3 | 62 | 93 | 139 | 179 | 201 | 223 | 249 | 282 | | |
| Slapy res. 1959 | Čihař (1961) | 433 | 84 | 120 | 150 | 177 | 199 | 203 | 254 | 282 | 330 | 351 |
| N. Živohošť 18. 5 1985 | own values | 22 | 65 | 111 | 142 | 155 | 172 | 184 | 183 | 201 | | |
| St. Živohošť, 18 5. 1985 | own values | 32♀♀ | 65 | 117 | 145 | 165 | 180 | 193 | 207 | | | |
| N. Živohošť, 10. 10 1985 | own values | 43♂♂ | 66 | 103 | 125 | | | | | | | |
| N Živohošť, 12 10 1985 | own values | 327 | 66 | 113 | 135 | 155 | 167 | 178 | 197 | | | |
| N. Živohošť, 21. 6 1986 | own values | 77♂♂ | 65 | 102 | 126 | 150 | 172 | | | | | |
| N. Živohošt 21. 6 1986 | own values | 21♀♀ | 65 | 100 | 128 | 149 | | | | | | |
| N. Živohošt, 21. 6 1986 | own values | 181 | 65 | 104 | 133 | 163 | 183 | 206 | 228 | | | |
| N. Živohošť, 11. 10. 1986 | own values | 91 | 59 | 92 | 124 | 157 | 192 | 208 | | | | |
| N. Živohošť, 11 10 1986 | own values | 115♂♂ | 63 | 104 | 133 | 153 | 167 | 176 | 181 | 192 | | |
| N. Živohošt, 11. 10. 1986 | own values | 116♀♀ | 64 | 104 | 131 | 153 | 168 | 183 | 193 | 208 | | |
| N. Živohošt, 16. 5. 0887 | own values | 39 | 67 | 107 | 135 | | | | | | | |
| N. Živohošt, 16 5. 1987 | own values | 222♂♂ | 66 | 107 | 135 | 156 | 177 | 205 | | | | |
| N. Živohošt, 16. 5. 1987 | own values | 137♀♀ | 70 | 116 | 144 | 167 | 191 | 217 | | | | |

Table 3. Parameters of the von Bertalanffy's equation of the perch from the Slapy reservoir ($L_\infty$ — the theoretically attainable maximum length, K — the growth coefficient, $t_0$ — the hypothetical starting age)

| Locality | Date of the capture | Sex | $L_\infty$ | K | $t_0$ |
|---|---|---|---|---|---|
| St. Živohošť | 18. 5. 1985 | females | 224 | 0.348 | 0.031 |
| N. Živohošť | 15. 5 1985 | | 202 | 0.392 | 0.011 |
| N. Živohošť | 12. 10. 1985 | females | 161 | 0.526 | 0.00032 |
| N. Živohošť | 12. 10. 1985 | males | 154 | 0.559 | − 0.00076 |
| N. Živohošť | 12. 10. 1985 | | 207 | 0.372 | 0.099 |
| N. Živohošť | 21. 6. 1986 | males | 205 | 0.350 | 0.030 |
| N. Živohošť | 21. 6. 1986 | females | 181 | 0.422 | 0.018 |
| N. Živohošť | 21. 6 1986 | | 283 | 0.226 | 0.012 |
| N. Živohošť | 11. 10. 1986 | males | 200 | 0.348 | 0.067 |
| N. Živohošť | 11. 10. 1986 | females | 222 | 0.309 | 0.123 |
| N. Živohošť | 11. 10. 1986 | | 207 | 0.187 | 0.075 |
| N. Živohošť | 16. 5. 1987 | | 180 | 0.459 | 0.0017 |
| N. Živohošť | 16. 5. 1987 | females | 260 | 0.287 | 0.015 |
| N. Živohošť | 16. 5. 1987 | males | 210 | 0.359 | 0.016 |
| Psané skály the brook | 5. 7. 1987 | | 253 | 0.266 | 0.056 |
| Mastník (see Hanel, 1988) | 1982 — 1985 | | 227 | 0.258 | 0.396 |

## RESULTS AND DISCUSSION

### Length growth

The length of the caudal find decreased with the increase in the body length, the average equation calculated from the total sample of the perch from the Slapy reservoir being· TL/BL = 1.2068 — 0.00019 BL (ranges of the BL 55—245 mm). The body length of the young of the year of the perch from the Slapy reservoir is given in Table 1. The data found are analogous with the values given by **Frank** (1967) and **Řepa** (1965, 1969) in the same locality They correspond with the data from the reservoir "Brněnská nádrž" in the year 1982 (**Kubečka**, 1984) and from the reservoir "Klíčavská nádrž" in the year 1956 (**Lohniský**, 1960). It is evident that the values from the Slapy reservoir are in good accordance with the body length back-calculated using the scale method. The perch material sampled in the years 1985—87 (without the young of the year) was formed by 1437 specimens which can be

Table 4. Proofs of phenomenon of Rosa Lee on samples of the perch from the Slapy riverne lake; average values are given in mm of the body length (for method see Hanel, 1982), $n$ — number of specimens

| | n | $l_1$ | $l_2$ | $l_3$ | $l_4$ | $l_5$ |
|---|---|---|---|---|---|---|
| 1985 | 18 | 68 | 108 | 144 | | |
| 1986 | 138 | 62 | 96 | 131 | 156 | |
| 1987 | 15 | 68 | 101 | 140 | 160 | 174 |
| | 171 | 0.0 | −3.5 | −2.0 | +4.0 | |

Table 5. Parameters of von Bertalanffy's growth equation of the perch from various Czechoslovak reservoirs

| Locality | Author | n | $l_\infty$ | K | $t_0$ |
|---|---|---|---|---|---|
| Šance, 1982 – 84 | Lojkásek (1986) | 210 | 520 | 0.088 | 0.256 |
| Římov | Hlaváček (1983) | 247 | 402 | 0.144 | 0.0064 |
| Klíčava (1963 – 64, 1967 – 79) | Pivnička (1982) | 3284 | 322 | 0.123 | −0.739 |
| Orava, 1958 – 62 (rapid growth) | Kirka (1964 | 39 | 320 | 0.274 | 0.057 |
| Orlík | Švátora (1974) | 52 | 221 | 0.334 | 0.749 |
| Horka | Švátora (1981) | 585 | 218 | 0.273 | 0.143 |
| Jesenice | Vostradovský (1965) | 48 | 217 | 0.4942 | 0.018 |
| Lipno | Švátora (1974) | 1204 | 209 | 0.153 | −0.784 |
| Hubenov | Švátora (1986) | 585 | 202 | 0.283 | 0.246 |
| Orava (1958 – 62) (slow growth) | Kirka (1964) | 205 | 187 | 0.265 | 0.094 |
| Záskalská res. | Švátora (1981) | 1024 | 177 | 0.425 | −0.064 |
| Pastvinská res. | Lohniský (1960) | 149 | 170 | 0.465 | 0.031 |
| Vranov, 1957 | Lohniský (1960) | 10 | 152 | 0.593 | 0.0097 |

*Table 6. Comparison of the length growth of the perch by the use of the $Cl_h$ index in some native reservoirs*

| Locality | Author | | $C_{lh(2-4)}$ | $C_{lh(2-5)}$ | $C_{lh(2-6)}$ | $C_{lh(2-7)}$ |
|---|---|---|---|---|---|---|
| Jesenice* | Vostradovský (1965) | | 140 | – | – | – |
| Orava | Kirka (1964) | ave. | 85 | 107 | 122 | 143 |
| | Hnatevič (1950) | min. | 53 | 77 | 86 | 99 |
| | | max. | 103 | 128 | 146 | 165 |
| Slapy | Frank (1960) | ave. | 81 | 100 | 118 | 106 |
| | Lohniský (1960) | min | 41 | 49 | 58 | 66 |
| | *own values* | *max.* | 102 | 118 | 153 | 145 |
| Římov* | Hlaváček (1983) | | 79 | 115 | 141 | 168 |
| the pond Rožmberk | Frank (1958) | | 74 | 101 | 127 | – |
| the pond Máchovo jezero | Frank (1958) | | 74 | 96 | 123 | 130 |
| Klíčava | Lohniský (1967) | ave. | 71 | 86 | 100 | 182 |
| | Švátora (1981) | min. | 56 | 72 | 90 | 125 |
| | | max. | 79 | 96 | 112 | 131 |
| Pastvinská n. 1957 (males) | Lohniský (1960) | | 70 | 78 | 87 | – |
| Šance*, 1982 – 84 | Lojkásek (1986) | | 70 | 94 | 130 | 156 |
| Záskalská res. | Švátora (1981) | ave. | 69 | 86 | 98 | 119 |
| | | min. | 64 | 81 | 93 | – |
| | | max. | 73 | 89 | 101 | – |
| Lipno | Vostradovský (1961) | ave. | 66 | 64 | 77 | 91 |
| | Švátora (1974) | min. | 41 | 53 | 63 | 77 |
| | | max. | 124 | 72 | 84 | 97 |
| Pastvinská res., 1957 (females) | Lohniský (1960) | | 66 | 76 | 85 | – |
| Horka* | Švátora (1986) | | 59 | 82 | 102 | 114 |
| Hubenov* | Švátora (1986) | | 56 | 72 | 88 | 99 |
| Mšeno | Vostradovský (1962) | | 49 | 60 | 73 | – |

* calculated from total average length growth

Table 7. Comparison of the length growth of the perch from various reservoirs outside of Czechoslovakia by the use of the $C_{lh}$ growth index

| Locality | Author | $C_{lh(2-4)}$ | $C_{lh(2-5)}$ | $C_{lh(2-6)}$ | $C_{lh(2-}$ |
|---|---|---|---|---|---|
| Ilmen lake (USSR) | Domračev, 1926 (see Berg, 1949) | 121 | 160 | 199 | 236 |
| Čana lake (USSR) rapid growth in females | Tjurin, 1935 (see Berg, 1949) | 114 | 144 | 168 | 194 |
| Lakes in Karelia (USSR) | Domračev, 1926 (see Berg, 1949) | 113 | 149 | 197 | — |
| Vitebsk lakes (USSR) | Domračev, 1926 (see Berg, 1949) | 105 | 138 | — | — |
| Čana lake (USSR) rapid growth in males | Tjurin, 1935 (see Berg, 1949) | 105 | 131 | 149 | 164 |
| Ullswater lake (England) females | McCormack (1965) | 86 | 99 | 109 | 116 |
| Ullswater lake (England) males | McCormack (1965) | 83 | 95 | 103 | 109 |
| Borga lake (Finnland) | Segerstrale, 1933 (see Lohniský, 1960) | 78 | 98 | — | — |
| Jääskjarvi (Finnland) | Valle (1944) | 75 | 100 | 116 | — |
| Rybinsk res. (USSR) | Šentjakova, 1959 | 68 | 94 | 115 | 129 |
| Ivanovsk res. (USSR) | Šentjakova, 1959 | 67 | 97 | 115 | 132 |
| Uglinsk res. (USSR) | Šentjakova, 1959 | 58 | 78 | 99 | 119 |
| ave. from German reservoirs | Roper, 1936 | 37 | 50 | 58 | 71 |

divided into 8 age groups. The most frequent were age groups 2 (in ave. of the total sample 35%), 3 (23%), 1 (19%) and 4 (17%). The most frequent were specimens with the body lengths of 130—135 mm (19%). The maximum body length of 245 mm was found in a specimen of the age 7. The perch with the maximum length within Czechoslovak waters was caught in the year 1976 in the river Stonávka. Its total length was 560 mm (calculated body length of 46 7mm) and the weight 2.3 kg the age was unknown (Hanel, 1987). In the year 1957 a perch was angled in the Slapy reservoir with the total length of 420 mm (calculated body length of 350 mm; the weight was 1150 g (Hanel, 1987). Vostradovský (1962) cited the perch from the reservoir Mšeno being of the age up to 18 The average body length growth in the Slapy reservoir during 1985—87 is presented in Table 2. The average length growth of females and males during the period of 1985—87 was very similar (body length in mm, females n = 306, males n = 457. females (males)· $l_1$ — 66/65, $l_2$ — 108/104, $l_3$ — 137/130, $l_4$ — 159/153, $l_5$ — 180/172. $l_6$ — 198/191. $l_7$ — 200/18 $l_8$ — 208/192. The faster growth of females than of males of the perch from various localities was reported by e.g. Lohniský (1960), Kirka (1964 Balon (1967). Gundrizer et al., (1981). The average length growth of the perch in the Slapy reservoir was better than in the brook Mastník (one of tributaries of the Slapy reservoir); see Hanel (1988). In Table 4 the total average values in mm) of Lee's phenomenon in the material examined are summarized (for the method see Hanel, 1982). From this Table it is clear, that Lee's phenomenon is indistinct. The problem is discussed in detail, e.g., in papers of Holčík (1969 a), Živkov (1980), Hanel (1982), Novák (1983) The length growth of the perch has the exponential mathematical form. The

Table 8. Parameters of the body length-elationship of the *perch from the Slapy reservoir* (*r* — correlation coefficient)

| Locality | Date of the capture | Author | n | Ranges of *BL* | a | b | r |
|---|---|---|---|---|---|---|---|
| Bučily | 6.–11. 9. 1957 | Frank (1960) | 76 | | –4.7844 | 3.0760 | |
| Cholín | 8.–10. 10. 1957 | Frank (1960) | 3 | | –4.5613 | 2 9402 | |
| Slapy res. | 1957 (♂♂) | Lohniský (1960) | 17 | | –4.9194 | 3.1429 | |
| Slapy res. | 1957 (♀♀) | Lohniský (1960) | 40 | | –5.8973 | 3.5939 | |
| St. Živohošť | 18. 5. 1985 (♀♀) | own values | 32 | 168–215 | –5.0850 | 3.1932 | 0.978 |
| N. Živohošť | 18. 5. 1985 (♂♂) | own values | 14 | 170–220 | –4.7557 | 3.0179 | 0.960 |
| N. Živohošť | 18. 5. 1985 | own values | 22 | 67–215 | –4.8242 | 3.0541 | 0 992 |
| Psané skály | 12. 8. 1985 | own values | 140 | 31– 48 | –5.3567 | 3.3709 | 0.989 |
| N. Živohošť | 12. 10. 1985 (♀♀) | own values | 148 | 79–148 | –4.2256 | 2.7859 | 0.995 |
| N. Živohošť | 12. 10. 1986 (♂♂) | own values | 43 | 69–140 | –4.9557 | 3.1531 | 0.992 |
| N. Živohošť | 12. 10. 1985 | own values | 112 | 66–230 | –4.5064 | 2.9055 | 0.996 |
| N. Živohošť | 21. 6. 1986 | own values | 181 | 62–245 | –4.1599 | 2.7598 | 0.992 |
| N. Živohošť | 21. 6. 1986 (♂♂) | own values | 77 | 74–185 | –4.2723 | 2.8046 | 0 997 |
| N. Živohošť | 21. 6. 1986 (♀♀) | own values | 21 | 125–175 | – 4.5772 | 2.9642 | 0.952 |
| Psané skály | 30. 6. 1986 | own values | 90 | 19– 33 | –4.7736 | 3.0367 | 0.990 |
| Psané skály | 4. 8. 1986 | own values | 914 | 27– 55 | –4.8721 | 3.0838 | 0.992 |
| N. Živohošť | 11. 10. 1986 (♀♀) | own values | 116 | 105–230 | –5.1882 | 3.2232 | 0.996 |
| N. Živohošť | 11. 10. 1986 | own values | 91 | 65–220 | –5.4455 | 3.3372 | 0.998 |
| N. Živohošť | 11. 10. 1986 (♂♂) | own values | 115 | 95–205 | –4.9657 | 3 1200 | 0.995 |
| N. Živohošť | 16. 5. 1987 (♂♂) | own values | 222 | 72–212 | –4.4581 | 2.8682 | 0.993 |
| N. Živohošť | 16. 5. 1987 (♀♀) | own values | 137 | 97–230 | –3.9983 | 2.6498 | 0.993 |
| N. Živohošť | 16. 5. 1987 | own values | 39 | 57–143 | –4.5289 | 2.8815 | 0.991 |

Table 9. Parameters of the body length/weight relationship of the perch from various Czechoslovak reservoirs and artificial fish ponds

| Locality | Author | Sex | a | b |
|---|---|---|---|---|
| Kličava res. 1956 | Lohniský (1960) | males | −4.5964 | 2.9481 |
| Kličava res. 1956 | Lohniský (1960) | females | −5.3224 | 3.3039 |
| Kličava res. 1957 | Lohniský (1960) | females | −5.1975 | 3.1589 |
| Kličava res. 1957 | Lohniský (1960) | males | −4.7360 | 3.0002 |
| Kličava res. (1963−79) | Švátora (1981) | | −4.7425 | 3.0145 |
| Pastvinská n. res. | Lohniský (1960) | males | −5.5191 | 3.3685 |
| Pastvinská n. res. | Lohniský (1960) | females | −5.5029 | 3.3631 |
| Orava (slow growth) | Balon (1967) | | −4.7043 | 3.0395 |
| Orava (rapid growth) | Balon (1967) | | −4.7043 | 3.0395 |
| Vranov res. | Lohniský (1960) | females | −5.3862 | 3.3328 |
| Mšeno res. | Vostradovský (1962) | | −4.1142 | 2.6722 |
| Záskalská res. res. (1974−79) | Švátora (1981) | | −4.9240 | 3.0867 |
| Šance res. (1982−84) | Lojkásek (1986) | | −4.4562 | 3.3623 |
| Slapy (upper part of the reservoir) | Lohniský (1960) | | −4.5191 | 2.9279 |
| Slapy (lower part of the reservoir) | Lohniský (1960) | | −5.0572 | 3.1669 |
| ponds in Českomoravská highland | Kříženecká-Pulánková (1952) | | −1.7775 | 3.646 |

growth curve was constructed, according to the growth model of von Bertalanffy (see Ricker, 1975). Parameters of these equations are presented in Tables 3 and 5, where they are compared also with other localities. Concerning the length growth, a broad variability was found in the perch from the Slapy

Table 10. The relationship between body length and Fulton's coefficient ($K_F$) of the perch from the Slapy reservoir

| Locality | Date of the capture | Sex | Equation | r |
|---|---|---|---|---|
| St. Živohošť | 18. 5.1986 | females | $K_F = 1.7519 + 0.0027\ BL$ | 0.323 |
| N. Živohošť | 18. 5.1985 | males | $K_F = 2.0213 - 0.0005\ BL$ | −0.269 |
| N. Živohošť | 18. 5.1986 | | $K_F = 1.8595 + 0.0007\ BL$ | 0.196 |
| N. Živohošť | 12.10.1986 | females | $K_F = 2.4345 - 0.0024\ BL$ | −0.437 |
| N. Živohošť | 12.10.1985 | males | $K_F = 1.5836 + 0.0060\ BL$ | 0.538 |
| N. Živohošť | 12.10.1985 | | $K_F = 2.1108 - 0.0010\ BL$ | −0.256 |
| N. Živohošť* | 21. 6.1986 | females | $K_F = 2.3738 - 0.0010\ BL$ | −0.0070 |
| N. Živohošť | 21. 6.1986 | males | $K_F = 2.5149 - 0.0033\ BL$ | −0.699 |
| N. Živohošť | 21.6. 1986 | | $K_F = 2.6628 - 0.0035\ BL$ | −0.561 |
| N. Živohošť | 11.10.1986 | males | $K_F = 1.6747 + 0.0019\ BL$ | 0.441 |
| N. Živohošť | 11.10.1986 | females | $K_F = 1.5366 + 0.0029\ BL$ | 0.664 |
| N. Živohošť | 11.10.1986 | | $K_F = 1.1416 + 0.0053\ BL$ | 0.858 |
| N. Živohošť | 16. 5.1987 | males | $K_F = 2.1782 - 0.0024\ BL$ | −0.487 |
| N. Živohošť | 16. 5.1987 | females | $K_F = 2.3742 - 0.0041\ BL$ | −0.777 |
| N. Živohošť | 16.5 1987 | | $K_F = 1.2724 + 0.0037\ BL$ | 0.354 |

* females after spawning

reservoir. Specimens with the body of, e.g., 177—208 cm can belong to five age group and therefore the "determination" of the age using only the body length is impossible. **Balon** (1967) described different populations of the perch from the reservoir Orava with fast and slow growth, too. The broad variability of the length growth ($C_{lh(2-4)}$ = 41—102) in the Slapy reservoir was found during the period of 1957—87. By comparing the periods of 1957—58 and 1985—87, I calculated in the average $C_{1h(2-6)}$ 106 and 122. respectively. Using this index it is possible to observe a rather better length growth, on average, in the second period mentioned. Having for comparison Tables 6 and 7, the growth in the Slapy reservoir can be designated as above the average as compared with other Czechoslovak reservoirs and below the average as compared with reservoirs outside own territory. The theoretically attainable body length in our own samples of the perch from the Slapy reservoir was found to be between 154—307 mm (see Table 3). The ranges of $C_{1h(2-6)}$ in the native reservoirs mentioned were found between 58—153 and in the neighbouring localities between 58—199 (see Tables 6 and 7).

Table 11. The comparison of the index of production following Pivnička (1972) among Czechoslovak reservoirs

| Locality | Author | | $P_{I(2-6)}$ | $P_{I(3-6)}$ | $P_{I(4-6)}$ | r $P_{I(3)}$ |
|---|---|---|---|---|---|---|
| Šance*, 1982—84 | Lojkásek (1986) | | 175 | 166 | 150 | 25 |
| Slapy | Frank (1960) | ave. | 140 | 113 | 88 | 55 |
| | Lohnický (1960) | min. | 52 | 50 | 27 | 25 |
| | own values | max. | 200 | 175 | 139 | 95 |
| Pastviny, 1957 (females) | Lohnický (1960) | | 109 | 95 | 77 | 32 |
| Klíčava*, 1963—79 | Švátora (1981) | | 104 | 80 | — | — |
| Záskalská n.* (1974—79) | Švátora (1981) | | 99 | 81 | 62 | — |
| Pastviny, 1957 (males) | Lohnický (1960) | | 92 | 70 | 47 | 45 |
| Klíčava, 1962 | Lohnický (1960) | | 88 | 76 | 58 | 30 |
| Lipno*, 1965—68 | Švátora (1974) | | 55 | — | — | — |
| Mšeno*, 1959 | Vostradovský (1962) | | 33 | 25 | — | — |

* calculated from total average weight growth

## Weight growth

Parameters of the length-weight relationship for the back calculation of the weight from samples obtained in the locality examined are summarized in Table 8. The "b" parameter ranged from 2.6498 to 3.5939; in females it was 3.0682, in males 3.0178, on the average. Parameters of the length-weight relationship from various Czechoslovak waters are given in Table 9. In the perch from mentioned Czechoslovak reservoirs, parameter "b" fluctuated between 2.6722 to 3.3685.

For the evaluation of the length and weight growth Fulton's coefficient of condition was calculated. The relationship of this conditional index to the body length is summarized in Table 10. Fulton's coefficient was found to be increasing in both sexes in various samples or also decreasing in dependence on the body length. In the perch from the reservoir Šance, **Lojkásek** (1986) found ranges of Fulton's coefficient falling between 1.26—2.31; he has found an increase of this coefficient with the age of specimens examined. In the perch in Czech ponds. Frank (1958) found ranges of this index 1.2 to 3 4, again increasing with the body length. In my material, I found these ranges between 1.42 and 2.51 in males and 1.26 and 2.68 in females. The values of the so-called index of production (see Pivnička, 1972) from various stagnant Czechoslovak waters are compared in Table 11. In the period of 1957—87, very broad variability of the weight growth was found using the index of production $P_{I(3-6)}$ = 50—166. Comparing the periods of 1957—58 and 1985—87, I calculated very similar average values $P_{I(2-3)}$ 55 and 56.

## SUMMARY

In 1985—87, the length and weight growth of the perch (*Perca fluviatilis*) in the Slapy reservoir (Central Bohemia) was studied, using the scale method, in 1437 young of the year and 2075 older specimens. Specimens under study represented age groups 0 to 8. On average the body length of the young of the year was 28 mm at the beginning of July and 44 mm in August. On average, the length growth of females and males was similar. The theoretically attainable body length ($L\infty$) in our own samples was found to be between 154—307 mm. The phenomenon of R. Lee was not too evident. According to the result of the length and weight growths and indexes evaluating the growth rate, the growth of the perch from the Slapy reservoir in 1957—87 may be evaluated as being above the average as compared with other Czechoslovak reservoirs and below the average as compared with reservoirs outside own territory. Ranges of $C_{1h(2-6)}$ index in native reservoirs fell between 58—153, and in neighbouring localities between 58—199. Teh average value of the "b" parameter of the length-weight relationship in the Slapy reservoir in females was 3.0682, in males 3.0178. Fulton's coefficient varied between 1.42—2.51 in males and 1.26—2.68 in females.

### Acknowledgements

Thanks are due to Assoc. Prof. O. Oliva Ph.D. for the encouragement during the work and critical reading of the manuscript. A valuable help during the field operations and during my studies of fish fauna in the Slapy reservoir was offered by Assoc. Prof. J. Hrbáček, D.Sc., Dr. Z. Brandl, Ph.D., Dr. V. Vavruška, Ph.D., Dr. J. Kubečka, Ph.D., L. Zelenka and all members of "The Anglers' Association" from the local section of Prague 10, Záběhlice.

## LITERATURE

*Alm G., 1946: Reasons for the occurrence of stunted fish populations with special regard to the perch (Meddelanden fran Statens undersoknings och försösanstalt för sötvatensfisket, 25). Stockholm.

Balon E. K., 1967: Vplyv životného prostredia na rast rýb v Oravskom priehradnom jazere. SAV, Bratislava, 123—175.

Berg L. S., 1949: Ryby presnych vod SSSR i sopredelnych stran. Izd. AN SSSR, Moskva-Leningrad.

Čihař J., 1961: Růst ryb ve Slapské údolní nádrži v roce 1959. ***Živočišná výroba***, 6(4): 295—302.

*Deedler C. L., 1950: Het ontstaan van de zwarte baars. ***Visserijnieuws***, 11: 131—132.

Frank S., 1958: Stáří a rychlost růstu okouna říčního (Perca fluviatilis Linné) v Čechách. ***Věst. čs. Společ. zool.***, 22(1): 45—58.

Frank S., 1959: Růst lína obecného a okouna říčního ve Slapské údolní nádrži. *Živočišná výroba*, 4(12): 893—896.

Frank S., 1960: Růst lína obecného a okouna říčního ve Slapské údolní nádrži. *Věst. čs. Společ. zool.*, 24(3): 258—270.

Frank S., 1967: The growth of perch, Perca fluviatilis, in the course of the first year of life in two valley reservoirs in Czechoslovakia. *Ichthyologica*, July-Dec., 155—*166*.

Geršanovič A. D., Markevič N. B., Dergaleva Ž. T., 1984: Ob ispol'zovanii koefficienta upitannosti v ichtiologičeskich issledovanijach. *Vopr. ichtiologii*, 24(5): 740—752.

Gundrizer A. N., Joganzen B. G., Kafanova V. V., Krivoščenkov G. M., 1981: Ryby Teleckogo ozera. Novosibirsk, Nauka, 1—160.

Hanel L., 1982: Note on the length growth of the chub (Leuciscus cephalus, Pisces, Cyprinidae) in the reservoir Klíčava and the river Berounka. *Věst. čs. Společ. zool.*, 46: 241—256.

Hanel L., 1987: K rekordním úlovkům okouna říčního. *Rybářství*, 10: 222.

*Hanel L., 1988: Příspěvek k poznání ryb potoka Mastník. Sborník vlastivěd. prací z Podblanicka*, 28(1987): 79—103.

Hanel L., 1989: Ryby Slapské údolní nádrže a jejího povodí. MS, Ph.D. Thesis, 1—160 (unpublished), Prague.

Hanel L., Čihař J., 1984: Ryby Slapské údolní nádrže. *Sborník vlastivěd. prací z Podblanicka*, 24(1983): 29—70.

Hlaváček M., 1983: Růst a stáři okouna říčního ve vodárenské nádrži Římov. Dipl. Thesis, České Budějovice, 1—45 (unpublished).

Hnatevič B., 1960: Das Wachstum des Barches (Perca fluviatilis L.) in dem Orava-Staubecken (Slowekei). *Z. f. Fischerei u. Hilfswiss.*, 9 (N. F.) (1/2): 85—93.

*Holčík J., 1969a: On the phenomenon of Rosa Lee exhibited by perch and roach* in the Klíčava reservoir. *Zool. listy*, 18(1): 93—97.

Holčík J., 1969b: The natural history of perch-Perca fluviatilis Linnaeus, 1758 in the Klíčava reservoir. *Práce Lab. rybárstva*, 2: 269—305.

Kirka A., 1964: Alter und Wachstum des Flussbarsches (Perca fluviatilis Linnaeus, 1758) im Orava Staubecken. *Věst. čs. Společ. zool.*, 28(4): 342—356.

Kříženecká-Pulánková A., 1952: Studie o vztahu mezi délkou a váhou u okouna říčního (Perca fluviatilis). *Věst. čs. Společ. zool.*, 16: 67—102.

Kubečka J., 1984: K poznání některých aspektů ekologie potěru ryb na Klíčavské údolní nádrži. Dipl. Thesis, 1—207 (unpublished).

*Kupčinskaja Je. S, 1987: Ekologičeskije osobennosti* Perca fluviatilis L. angarskoj časti Usť-Ilimskogo vodochranilišča. *Vopr. ichtiologii*, 27, 2: 213—220.

Lee R. M., 1920: A review of the method of age and growth determination in fishes by means of scales. Ministry Agr. and Fish., Fishery Invest., ser. II, 2, 2, London.

Lohniský K., 1960a: Bemerkungen zum Wachstum des Flussbarsches (Perca fluviatilis L. 1758). *Acta Univ. Carol.*, 3: 241—273.

Lohniský K., 1960b: Růst okouna říčního (Perca fluviatilis Linnaeus, 1758) ve Slapské údolní přehradě. *Čas. Nár. musea — odd. přír.*, 129, 2: 174—181.

Lohniský K., 1967: Potrava a růst okouna říčního v prvních deseti letech existence vodárenské nádrže Klíčava. *Živočišná výroba*, 12(1): 223—242.

*Lojkásek B., 1986: Růst okouna říčního (Perca fluviatilis) ve vodárenské nádrži* Šance. *Živočišná výroba*, 31(10): 921—926.

McCormack J. C., 1965: Observations on the perch population of Ullswater. *J. Anim. Ecol.*, 34: 463—478.

Novák J., 1982: Comparison of two different methods of growth values computation illustrated on rudd scales (Pisces: Cyprinidae). *Věst. čs. Společ. zool.*, 46: 25—32.

Novák J., 1983: Notes on the phenomenon of Rosa Lee illustrated on the rudd growth (Scardinius erythophthalmus, Pisces, Cyprinidae). *Věst. čs. Společ. zool.*, 47: 169—174.

Pivnička K., 1972: *Index of production — a new parameter for evaluation of* growth and production capacity of fish illustrated with reference to roach, Rutilus rutilus (Linnaeus, 1758). *Věst. čs. Společ. zool.*, 36(4): 269—274.

Pivnička K., 1982: Long-termed study of fish populations in the Klíčava reservoir. *Acta Sc. Nat. Brno*, 16(10): 1—46.

Ricker W. E., 1975: Computation and interpretation of biological statistics of fish populations. *Bull. Fish. Res. Board Can.*, 1—382.

Rounsefell G. A, Everhart W. H., 1960: Fishery science. Its methods and application. J. Wiley and sons. Publ , 1—455.

Roper K. C, 1936: Ernahrung und Wachstum des Barsches (Perca fluviatilis L.) in Gewässern Mecklenburgs und der Mark Brandenburg. Dissertation, Druck J. Neumann-Neudamm, 1—76.

Řepa P., 1965: Růst, výživa a morfologie raných stádií okouna říčního, Perca fluviatilis (Linnaeus, 1758) v údolních nádržích. Dipl. Thesis, 1—165. (unpublished)

Řepa P., 1969 Nahrung und Wachstum des Flussbarsches (Perca fluviatilis Linnaeus, 1758) in seinem ersten Lebensjahr. *Věst. čs. Společ. zool.*, 33(2): 135—150

*Shafi M., Maitland P. S., 1971: The age and growth of perch (Perca fluviatilis L.) in two Scottish lochs. *J. Fish. Biol.*, 3· 39—57.

*Šentjakova L. F., 1959: Nekotoryje osobennosti rosta okunja *Trudy inst biol. vodochr.*, 1(4): 298—308.

Švátora M, 1974: Růst okouna říčního (Perca fluviatilis L.) v některych údolních nádržích. *Živočišná výroba,* 19(47), 9· 661—668.

Švátora M., 1981: Dynamika rybích populací v Záskalské údolní nádrži MS, Ph.D. Thesis, Prague, 11—37 (unpublished).

Švátora M., 1986: Okoun říční ČSR, Praha, 1—86.

Valle K. J., 1944: Tutkimuksia kalojen kasvusta eraissa karjalan järvissa *Ann. Zool. Soc. Zool. Bot. Fenn. Vanamo,* 11(1): 1—66.

Vostradovský J., 1961: K biologii a růstu kapra obecného, okouna říčního a jelce proudníka v nové údolní nádrži Lipno. *Živočišná výroba,* 6(34), 4· 287—294

Vostradovský J, 1962: K bionomii okouna říčního (Perca fluviatilis L) v údolní nádrži Mšeno. *Sbor. severočes, mus., Liberec,* 2: 159—173.

Vostradovský J., 1965: Ichthyofauna údolní nádrže Jesenice v prvých třech letech po napuštění. *Zpr. mus. západočes. kraje, Příroda,* 3—4: 1—15.

Živkov M. T, 1980: K metodike izučenija fenomena Li i kompensacionnogo rosta ryb. *Hidrobiologia,* 11: 39—56.

* not seen in original

Received December 1, 1989; accepted June 7, 1990

*Acta Soc. Zool. Bohemoslov.*, **54**: 259—267, 1990
ISSN 0862—5247

# PREDICTING THE TIME OF MORNING DEPARTURE FROM WINTER COMMUNAL ROOSTS IN CORVUS FRUGILEGUS (AVES: PASSERIFORMES)

Zdeněk HUBÁLEK

Institute of Systematical and Ecological Biology, Czechoslovak Academy of Sciences,
Květná 8, 603 65 Brno, Czechoslovakia

Abstract. The onset of morning dispersal of rooks (*Corvus frugilegus* L.) was observed on 151 occasions at two large communal roosts in winter. Eleven environmental variables were recorded and their effects on the time of departure (TD) of the birds determined by statistical methods of simple regression and correlation, polynomial regression, and multiple regression. The best predictors of TD in the multiple regression were the beginning of local civil twilight, cloudiness, precipitation, snow cover, horizontal visibility and wind direction. A suggested regression equation explained 78% of total variance; maximum differences between observed and expected values were —9 and +12 min, and the mean difference with standard deviation was 0.0 ± 3.7 min.

## INTRODUCTION

The rooks (*Corvus frugilegus* L.) wintering in Czechoslovakia use a multitude of regular communal roosts at night (Hubálek et Kubík 1983). In this species, the roosting behaviour is generally very orderly and precise, including the times of morning departure from, and evening entry into, the roost (Zdobnitzky 1907; Gramet 1956; Rappe 1965; Heitkamp 1970; Grodziński 1971, 1980; Swingland 1976, 1977; Hubálek 1978; Hubálek et Kubík 1983).

In a previous study (Hubálek 1978), the effect of environmental variables on the morning departure of rooks from two winter roosts was studied by simple statistical methods. The same set of data has recently been analyzed by more sophisticated multivariate procedures in order to suggest a formula predicting the time of birds' dispersal in the morning. This matter has not yet been treated adequately in ornithology.

## MATERIAL AND METHODS

The morning departures of wintering rooks were observed at two large communal roosts situated near Židlochovice and Vysoké Mýto on 151 occasions, as described in the previous paper (Hubálek 1978). The following environmental variables were recorded 30 min before local sunrise (unless otherwise indicated):

X0, light intensity at the local sunrise time, measured and expressed as the exposimeter relative values.

X1, cloudiness, in scores 0 to 12: the scores 0 to 9 correspond to the standard scale (0—10, tenths sky covered); 10, overcast with the clouds light; 11, overcast with the clouds moderate, 12, overcast with the clouds dense.

X2, snow cover, in scores 0 to 3: 0, absent; 1, discontinuous; 2, continuous, less than 10 cm; 3, continuous, 10 cm or more.

X3, precipitation, in scores 0 to 4: 0, nil; 1, light snowfall; 2, moderate snowfall or drizzle; 3, dense snowfall or moderate rainfall; 4, dense rainfall.

Table 1. Correlation between timing of birds' departure (Y1, Y2) and environmental variables X0 to X9. Boldfaced values of the coefficients of Pearson ($r$), Kendall ($\tau$) and Spearman ($r_S$) are significant at P = 0.01

| | Y1 | | | Y2 | | |
|---|---|---|---|---|---|---|
| | $r$ | $\tau$ | $r_s$ | $r$ | $\tau$ | $r_S$ |
| **X0** | **−0.776** | **−0.618** | **−0.805** | −0.185 | −0.120 | −0.168 |
| **X1** | **0.721** | **0.623** | **0.793** | 0.127 | 0.111 | 0.160 |
| **X2** | −0.140 | −0.096 | −0.030 | **−0.292** | **−0.251** | **−0.210** |
| **X3** | **0.539** | **0.390** | **0.601** | **0.411** | **0.306** | **0.535** |
| **X4** | **0.236** | **0.157** | 0.194 | **0.216** | **0.211** | **0.273** |
| **X5** | **−0.312** | **−0.175** | **−0.247** | **−0.338** | **−0.201** | **−0.266** |
| **X6** | **0.341** | **0.278** | **0.407** | 0.191 | 0.137 | 0.200 |
| **X7** | −0.188 | −0.107 | **−0.219** | −0.104 | −0.061 | −0.134 |
| **X8** | **0.275** | **0.236** | **0.275** | **0.231** | **0.225** | **0.260** |
| **X9** | 0.089 | 0.045 | 0.060 | 0.189 | 0.117 | 0.171 |

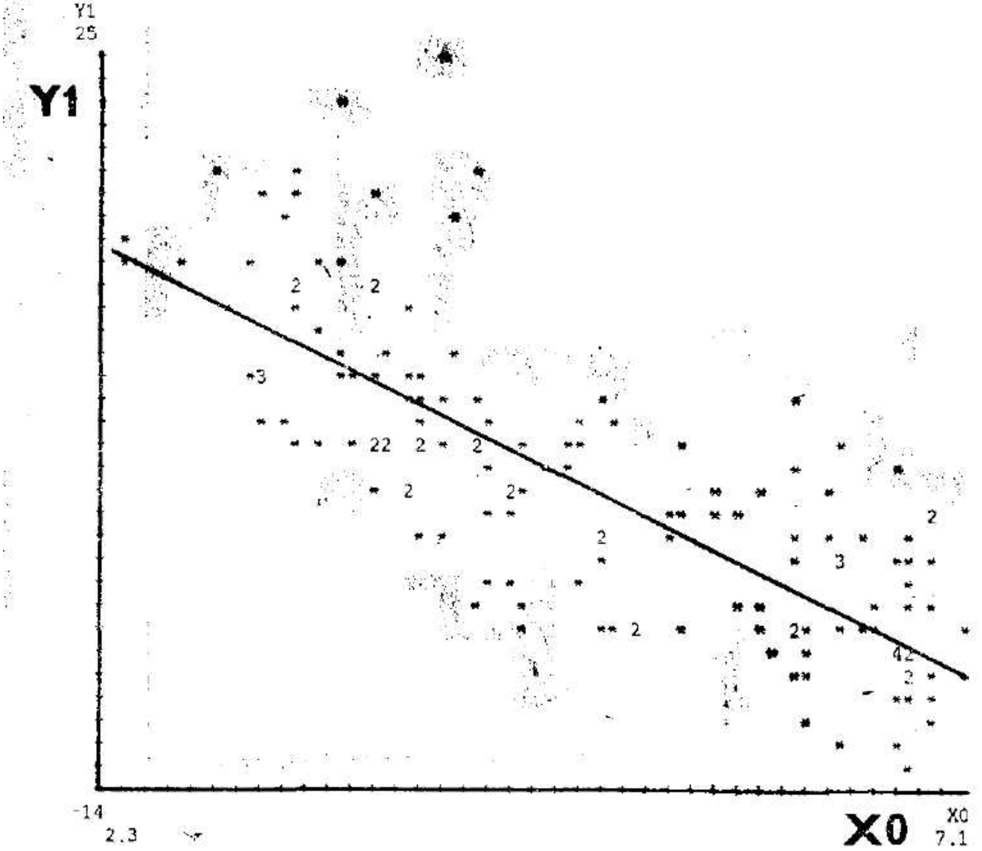


Fig. 1. Linear regression of timing of birds' departure (Y1) on light intensity (X0). The equation is $Y1 = 24.46 - 4.64485\ X0$. ($R^2 = 0.602$).

Tab. 2. Correlation among environmental variables X0 to X9. Significant values boldfaced ($P < 0.01$)

| | | X0 | X1 | X2 | X3 | X4 | X5 | X6 | X7 | X8 |
|---|---|---|---|---|---|---|---|---|---|---|
| X1 | r | **−0.929** | **1.000** | | | | | | | |
| | τ | **−0.854** | **1.000** | | | | | | | |
| X2 | r | −0.040 | 0.125 | **1.000** | | | | | | |
| | τ | −0.052 | 0.102 | **1.000** | | | | | | |
| X3 | r | **−0.419** | **0.363** | 0.076 | **1.000** | | | | | |
| | τ | **−0.352** | **0.363** | 0.105 | **1.000** | | | | | |
| X4 | r | −0.144 | 0.133 | 0.078 | **0.235** | **1.000** | | | | |
| | τ | −0.055 | 0.096 | 0.053 | **0.257** | **1.000** | | | | |
| X5 | r | 0.142 | −0.135 | −0.076 | −0.140 | **−0.553** | **1.000** | | | |
| | τ | 0.097 | −0.117 | −0.098 | −0.166 | **−0.493** | **1.000** | | | |
| X6 | r | **−0.363** | **0.323** | **−0.368** | 0.164 | 0.052 | 0.126 | **1.000** | | |
| | τ | **−0.268** | **0.227** | **−0.316** | 0.096 | 0.048 | 0.058 | **1.000** | | |
| X7 | r | 0.162 | 0.117 | 0.082 | **−0.219** | **−0.257** | 0.080 | −0.028 | **1.000** | |
| | τ | 0.085 | −0.077 | 0.113 | **−0.164** | −0.113 | 0.053 | 0.012 | **1.000** | |
| X8 | r | −0.205 | 0.162 | −0.024 | 0.047 | 0.036 | −0.094 | 0.189 | −0.075 | **1.000** |
| | τ | **−0.172** | **0.152** | −0.008 | 0.080 | 0.026 | −0.085 | 0.114 | −0.092 | **1.000** |
| X9 | r | 0.024 | −0.049 | **−0.250** | 0.043 | 0.010 | −0.025 | **0.231** | 0.012 | 0.063 |
| | τ | 0.026 | −0.049 | **−0.184** | 0.012 | 0.016 | −0.022 | **0.150** | −0.021 | 0.024 |
| | | X0 | X1 | X2 | X3 | X4 | X5 | X6 | X7 | X8 |

$X4$, relative humidity of the air, in %.

$X5$, horizontal visibility, in scores 0 to 6: 0, below 100 m; 1, 100 to 200 m; 2, 200 to 500 m; 3, 500 to 1000 m; 4, 1000 to 3000 m; 5, 3000 to 5000 m; 6, more than 5000 m.

$X6$, air temperature, in °C.

$X7$, barometric pressure trend overnight (vs 21 hr), in torr.

$X8$, wind direction (at windspeeds 1° Beauf. or more), in scores 0 to 3: 0, NNE to E; 1, W to N, 2, SEE to S; 3, SSW to WSW.

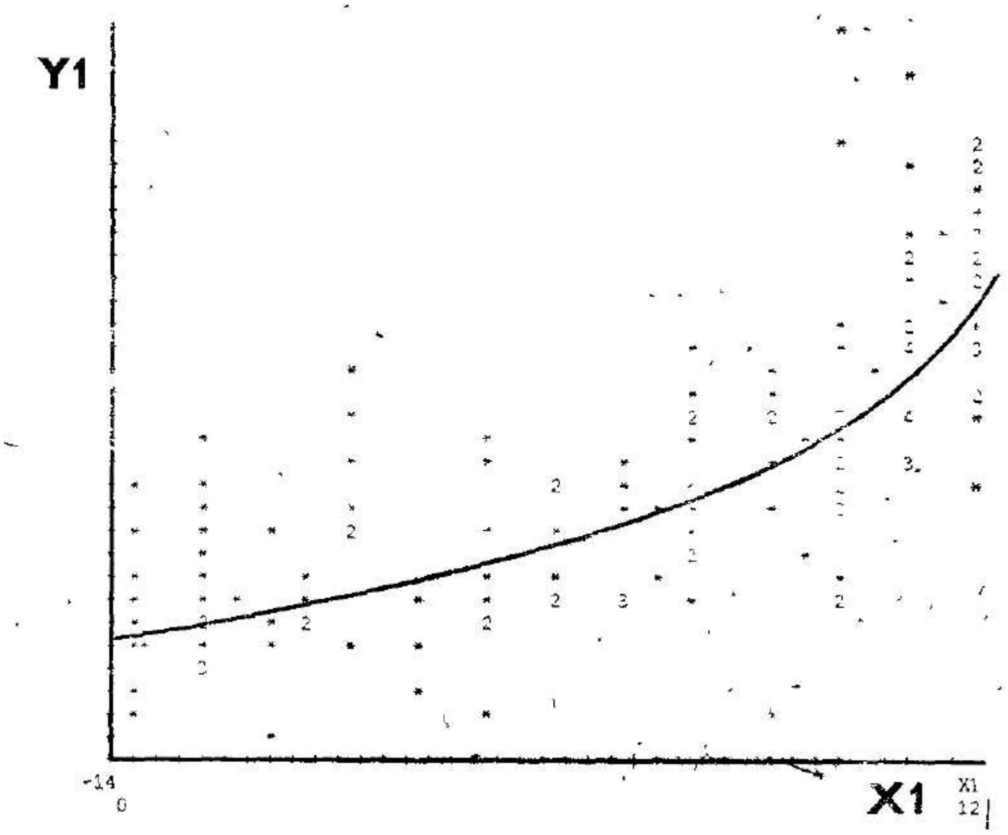


Fig. 2. Polynomial regression of timing of birds' departure ($Y1$) on cloudiness ($X1$). The best fit equation of the second degree polynom is $Y1 = -5.50 - 0.69721\ X1 + 0.17225\ (X1)^2$. ($R^2 = 0.584$). Linear regression explains less of the variance: $Y1 = -9.37 + 1\ 46624\ X1$. ($R^2 = 0.520$).

$X9$, day length, in min (the interval between the local sunrise and local sunset).

Other variables, not found as significant in the previous study (Hubálek, 1978), were omitted: roost location; hoarfrost; barometric pressure; windspeed; moon phase; moonlight in the morning.

The timing of the birds' departure from the roost was described by two dependent variables $Y1$ and $Y2$ defined as:

$Y1 = TD - BCT$, i.e. the difference (in min) between the time of birds' departure (TD) and beginning of local civil twilight (BCT).

$Y2 = Y1 - Y'$, where $Y'$ is $(TD - BCT)'$ expected on the basis of light intensity: $Y' = 20.28 - 4\ 1165\ X0$ (see Results); the use of $Y2$ variable eliminates the effects of light intensity (and cloudiness).

Calculations were performed on personal computer **HP Vectra XT**, using the statistical packages *Microstat* and *Costat*, based on diverse univariate and multivariate procedures, including the algorithms of both stepwise and backwards multiple regression (Snedecor et Cochran 1967, Cooley et Lohnes 1971).

## RESULTS

### Simple linear regression and correlation

A significant linear regression of Y1 on the light intensity was ascertained in the previous study (Hubálek 1978) Repeated analysis, based on selected observations (103 cases) under conditions with no precipitation and fog, confirmed that finding: the regression equation was $Y' = 20.28 - 4.1165\ X0$, and

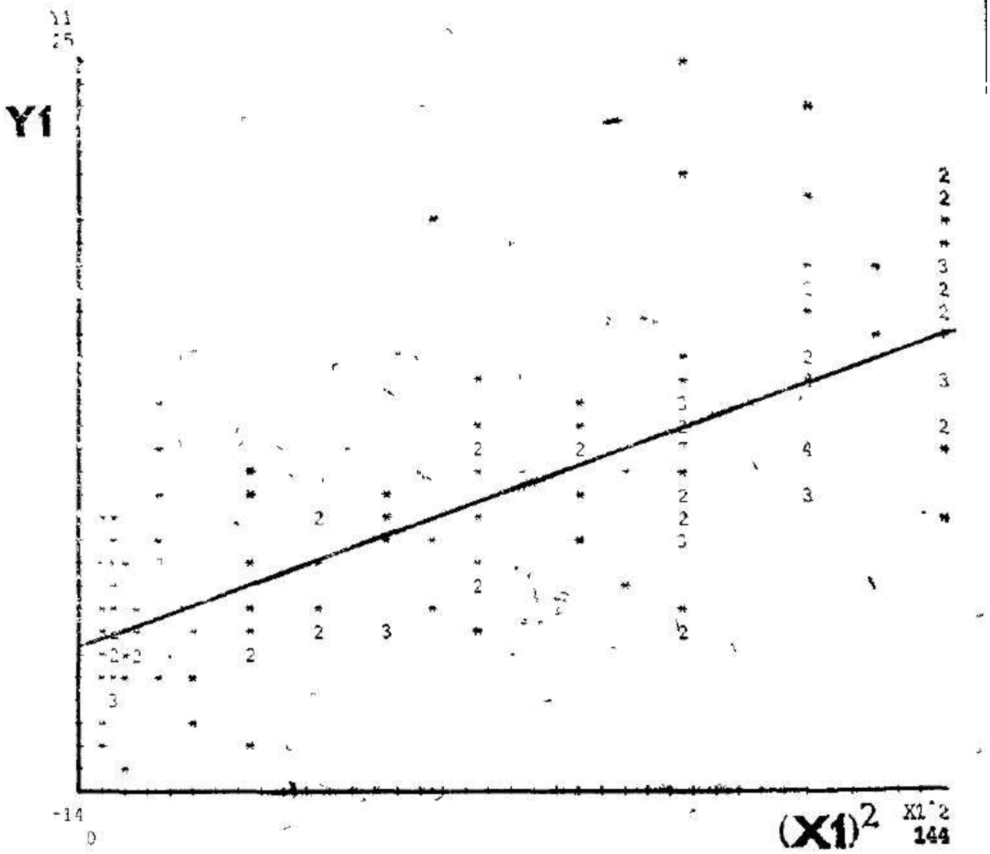


Fig. 3. Linear regression of timing of birds' departure (Y1) on cloudiness (transformed, squared X1 values). The equation is $Y1 = -6.95 + 0.11969\ (X1)^2$ ($R^2 = 0.578$).

the coefficient of correlation (r) was $-0.802$ ($P < 0.001$). Using this equation, Y2 values were calculated as Y1—Y', where Y' is the difference TD-BCT expected on the basis of particular value of X0.

Correlations among all variables were than evaluated (Tab. 1, 2) by parametric and non-parametric (rank) coefficients of Pearson ($r$), Kendall ($\tau$) and Spearman ($r_S$), based on 151 cases. Significant ($P < 0.01$) correlations were found between Y1 variable and the variables X0. X1, X3. X6, X5, X8 and X4, and between Y2 and X3, X5, X2, X8 and X4. The variables Y1 and Y2 are also highly correlated ($r = 0.751$, $\tau = 0.523$. $r_S = 0.679$; $P < 0.001$). and the corresponding regression equations were $Y2 = 0.75 + 0.4696\ Y1$; $Y1 = -0.25 + 1.2008\ Y2$. Closely interdependent ($r = -0.929$) environmental descriptors are only X0 and X1, i.e. light intensity and cloudiness; corresponding regression equations were $X0 = 7.28 - 0.3156\ X1$, and $X1 = 20.93 - 2.7352\ X0$. Other significant interrelations (but any of them with $r < 0.60$) were found between X4 and X5; X6 and X2, X0, X1; X1 and X3; X5 and X9; X7 and X4, X3; X0 and X8 (Tab. 2).

Significant ($P < 0.01$) linear regression equations for Y1 and Y2 dependent variables were: $Y1 = 24.46 - 4.6448\ X0$ (Fig. 1); $Y1 = -9.37 + 1.4662\ X1$; $Y1 = -0.25 + 6.0163\ X3$; $Y1 = -21.94 + 0.2627\ X4$; $Y1 = 8.48 - 1.7851\ X5$; $Y1 = 2.22 + 0.7346\ X6$; $Y1 = -1.95 + 2.2818\ X8$.
$Y2 = 2.57 - 1.3347\ X2$; $Y2 = 0.62 + 2.8647\ X3$; $Y2 = -11.93 + 0.1497\ X4$; $Y2 = 6.15 - 1.2075\ X5$; $Y2 = -0.23 + 1.1830\ X8$.

## Polynomial regression

Stepwise polynomial regression of Y1 and Y2 on each X variable was then tested up to the fourth degree. The only significant ($P < 0.05$) polynomial regressions were found between Y1 and X1 (2nd degree polynomial — Fig. 2), X5 (2nd degree polynomial); Y2 and X4 (3rd degree polynomial), X5 (3rd degree polynomial). The corresponding polynomial equations were (the values of $R^2$ in parentheses show the proportions of variance explained, compared with similar $R_1^2$ values for the simple linear regression of the first degree):

$$Y1 = -5.50 - 0.6972\ X1 + 0.1722\ (X1)^2 \quad (R^2 = 0.584 \text{ vs. } R_1^2 = 0.520)$$
$$Y1 = 17.37 - 7.1768\ X5 + 0.7054\ (X5)^2 \quad (R^2 = 0.137 \text{ vs. } R_1^2 = 0.097)$$
$$Y2 = -171.47 + 8.3047\ X4 - 0.1256\ (X4)^2 + 0.0006\ (X4)^3$$
$$(R^2 = 0.168 \text{ vs. } R_1^2 = 0.046)$$
$$Y2 = 17.07 - 10.9880\ X5 + 2.5089\ (X5)^2 - 0.1939\ (X5)^3$$
$$(R^2 = 0.176 \text{ vs. } R_1^2 = 0.114).$$

The particular polynomial regression equations explain thus by 6.4% (Y1 on X1), 4.0% (Y1 on X5), 12.1% (Y2 on X4) and 6.2% (Y2 on X5) more variance than the corresponding simple regressions of the first degree. For instance, when the scatterplots of the regression of Y1 on either X1 or $(X1)^2$ were compared, the regression was moderately curvilinear in the first case (X1), while linear in the latter (Fig. 2, 3). Simple linear regression equation in this case was $Y1 = -6.95 + 0.1197\ (X1)^2$, with correlation coefficient ($r = 0.760$; $P < 0.001$) greater than that between Y1 and X1 ($r = 0.721$). Also the correlation between $(X1)^2$ and X0 was higher ($r = -0.949$) than that between X1 and X0 ($r = -0.929$). The values of significant correlation coefficient $r$ between $(X1)^2$ and other environmental descriptors were 0.409 for X3, and 0.294 for X6.

Therefore new, transformed environmental variables $(X1)^2$, $(X4)^2$, $(X4)^3$, $(X5)^2$ and $(X5)^3$ were added to the data set in order to enable a more efficient multivariate regression analysis.

### Multiple regression

The results of univariate analyses revealed two pairs of closely inter-related variables, viz. **Y1 and Y2**; **X0 and X1. These variables should be treated separately** in the multivariate procedures. Consequently, six sets of variables were selected and used in the multiple regression analyses:

DEP 1: Y1 vs. X1. X2, X3, X4, X5, X6, X7. X8. X9.
DEP 12: Y1 vs. X1, $(X1)^2$, X2. X3, X4, X5, $(X5)^2$. X6, X7. X8 X9.
DEP 3: Y1 vs. X0. X2, X3, X4. X5. X6, X7, X8. X9.
DEP 32: Y1 vs. X0, X2, X3, X4. X5, $(X5)^2$, X6. X7, X8, X9.
DEP 5: Y2 vs. X2. X3. X4, X5, X6, X7, X8, X9.
DEP 53: Y2 vs. X2, X3, X4, $(X4)^2$, $(X4)^3$, X5, $(X5)^2$, $(X5)^3$, X6, X7. X8, X9.

The best subsets of environmental variables were defined as those, which minimized sufficiently the residual sum of squares (this is equivalent to maximizing the multiple correlation coefficient and $R^2$); only those descriptors contributing significantly ($P < 0.05$) to the explanation of variability were included in the best subsets. In all cases, the results of both stepwise and backwards multiple regression algorithms were identical. The resulting best regression equations for particular sets of variables contain the environmental descriptors arranged according to their descending importance in partial correlation, and the value of $R^2$ indicates proportion of the total variance explained. Analysis of residuals (i.e. differences between the Y values observed and predicted) is also presented, as the arithmetic mean, standard deviation (SD), minimum and maximum difference values.

DEP 1: $Y1 = -4.69 + 1.1617\ X1 + 3.7237\ X3 - 1.6839\ X2 - 1.0168\ X5 + 1.3279\ X8$ ($R^2 = 0.752$).
Variables not in equation: X4, X6, X7, X9 ($R^2 = 0.755$, if they were included).
Residuals: $x = 0.09$; SD = 4.04; Min = —9.0; Max = +16.4.

DEP 12: $Y1 = 4.54 + 0.0944\ (X1)^2 + 3.2873\ X3 - 1.6425\ X2 - 5.0763\ X5 + 0.5264\ (X5)^2 + 1.0614\ X8$ ($R^2 = 0.784$).
Variables not in equation: X1, X4, X6, X7, X9 ($R^2 = 0.790$, if they were included).
Residuals: $\bar{x} = 0.00$; SD = 3.72; Min = —9.4; Max = +12.1.

DEP 3: $Y1 = 21.89 - 3.6305\ X0 + 3.1541\ X3 - 1.3180\ X2 - 0.9862\ X5 + 1.0693\ X8$ ($R^2 = 0.761$).
Variables not in equation: X4, X6, X7, X9 ($R^2 = 0.763$, if they were included).
Residuals: $\bar{x} = 0.03$; SD = 3.97; Min = —9.4; Max = +16.8.

DEP 32: $Y1 = 27.56 - 3.5794\ X0 + 3.1622\ X3 - 1.3992\ X2 - 4.2341\ X5 + 0.4129\ (X5)^2 + 0.9174\ X8$ ($R^2 = 0.773$).
Variables not in equation: X4, X6, X7, X9 ($R^2 = 0.776$, if they were included).
Residuals: $\bar{x} = 0.00$; SD = 3.84; Min = —9.0; Max = +13.3.

DEP 5: $Y2 = 4.01 + 2.8793\ X3 - 1.4120\ X2 - 0.9544\ X5 + 1.0176\ X8$ ($R^2 = 0.412$).
Variables not in equation: X4, X6, X7, X9 ($R^2 = 0.424$, if they were included).

Residuals: $\bar{x} = -0.01$; SD = 3.82; Min = —8.1; Max = +16.9.

DEP 53: $Y2 = 15.20 + 2.8875\ X3 - 1.4384\ X2 - 10.2382\ X5 + 2.3016\ (X5)^2 - 0.1731\ (X5)^3 + 0.8322\ X8$ ($R^2 = 0.472$).

Variables not in equation: X4, $(X4)^2$, $(X4)^3$, X6, X7, X9 ($R^2 = 0.511$, if they were included).

Residuals: $x = 0.00$; SD = 3.48; Min = —8.4; Max = +10.8.

Individual equations explain the following proportions of the full model (i.e. with all environmental descriptors selected) variance and total variance, respectively: DEP 1: 99.7% and 75.2%; DEP 12: 99.2% and 78.4%; DEP 3: 99.7% and 76.1%; DEP 32: 99.6% and 77.3%; DEP 5: 97.1% and 41.2%; DEP 53: 92.3% and 47.2%. This shows that the extraction of variables in subsets was markedly effective and, moreover, that the sets DEP 12, DEP 32 and DEP 53 involving also the variables transformed to the second or third degree yielded slightly better Y prediction than the corresponding sets DEP 1, DEP 3 and DEP 5, containing only the variables of the first degree. In general, the most optimal predictive equation is that based on DEP 12 set of descriptors.

## DISCUSSION

Significant simple regressions were detected of Y1 on the light intensity (X0), cloudiness (X1), precipitation (X3), temperature (X6), horizontal visibility (X5), wind direction (X8) and r.h. of the air (X4), and, similarly, of Y2 on X3, X5, X2 (snow cover), X8 and X4. Y2 variable, by definition, eliminates the effects of light intensity (X0) and cloudiness (X1) on TD. Nevertheless, significant regressions of the time of departure on precipitation, horizontal visibility, snow cover wind direction and relative humidity were demonstrated. The influence of these variable on the onset of birds' dispersal in the morning seems thus be substantiated, in addition to primary effects of the light intensity (X0) inter-related closely with, and affected by, the cloud cover (X1) and BCT as well. On the other hand, the variables X7 (barometric pressure trend) and X9 (day length) were not found to be significant.

Multiple regression analyses, aimed at the construction of predictive equations, resulted in a similar subset of significant environmental descriptors, though reduced in number to five or six (X0 X1, X3, X2, X5 and X8), whereas the variables X4, X6, X7 and X9 could have not been included in the equations. Light intensity (X0) or cloudiness (X1) alone explained 54% to 63% of variance of Y1, and the best multivariate regression (based on DEP 12) as much as 78.4% of total variance. This equation has been constructed as $TD = BCT + 0.0944\ (X1)^2 + 3.2873\ X3 - 1.6425\ X2 - 5.0763\ X5 + 0.5264\ (X5)^2 + 1.0614\ X8 + 4.54$.

Maximum differences between observed and expected (predicted) values have been —9.4 min and +12.1 min, with the mean difference of 0.0 min and standard deviation of the differences ±3.7 min. These results suggest an effective prediction of TD from winter communal roosts in *C. frugilegus* at temperate latitudes. The predictors are the local civil twilight (BCT), cloudiness, precipitation, snow cover, horizontal visibility and wind direction. These environmental factors affect the morning dispersal of rooks considerably. In general, the light intensity (determined by BCT and cloudiness) might be regarded as the primary factor, while precipitation, snow cover and horizontal visibility (the latter correlating with relative humidity of the air) as major modifying factors, and wind direction as a minor modifying factor in the timing mechanisms.

Interestingly, no significant effects of the variables X4 (relative humidity), X6 (temperature), X7 (barometric pressure trend) and X9 (day length) on TD have been detected in the multivariate comparison, in contrast to the results of simple statistical analysis (Hubálek 1978). One reason might be that these variables correlate with other, dominating factors: e.g., X4 with X5 and X3, X6 with X1 (X0) and X2, X9 with X2, and X7 with X3

Cooley W. W. et Lohnes, P. R., 1971: Multivariate data analysis. J. Wiley, New York.

Gramet P., 1956: Observations sur le processus d'arrivée et de départ du dortoir chez certains corbeaux. *Bull. Soc. Zool. Fr.*, 81: 207—217.

Grodziński Z., 1971: Daily flights of rooks Corvus frugilegus Linnaeus, 1758 and jackdaws Corvus monedula Linnaeus, 1758 wintering in Cracow. *Acta zool. cracov.*, 16: 735—772.

Grodziński Z., 1980: The annual life cycle of rooks Corvus frugilegus Linaeus, 1758 and jackdaws Corvus monedula Linnaeus, 1758, in the town of Cracow. *Acta zool. cracov.*, 24: 375—410.

Heitkamp U., 1970: Schlafplatzbeobachtungen an Corviden. *Vogelk. Ber. Niedersachs.*, 2: 75—78.

Hubálek Z., 1978: Morning departure of rooks (Corvus frugilegus) from the winter roost. *Věst. čs. Společ. zool.*, 42: 1—14.

Hubálek Z. et Kubík, V., 1983: Roosts and habits of Corvus frugilegus wintering in Czechoslovakia. *Acta Sc. nat. Brno*, 17(1): 1—52.

Rappe A, 1965: Notes sur des dortoirs de corvides. *Gerfaut*, 55: 4—15.

Snedecor G. W. et Cochran, W. G., 1967: Statistical methods. 6th ed. The Iowa State Univ. Press, Ames.

Swingland I. R., 1976. The influence of light intensity on the roosting times of the Rook (Corvus frugilegus). *Anim. Behav.*, 24: 154—158.

Swingland I. R., 1977: The social and spatial organization of winter communal roosting in rooks (Corvus frugilegus). *J. Zool. (Lond.)*, 182: 509—528.

Zdobnitzky F., 1907: Das Winterleben unserer Corviden (insbesondere von Corvus frugilegus L.) in der weiteren Umgebung Brünns. *Z. mähr. Landesmus.*, 7: 98—124.

Received November 9, 1989, accepted June 7, 1990

*Acta Soc. Zool. Bohemoslov.*, **54**: 268—286, 1990
ISSN 0862—5247

# SOME NEMATODE PARASITES OF FROGS FROM PAPUA NEW GUINEA AND AUSTRALIA

František MORAVEC[1] and Ottó SEY[2]

[1]Institute of Parasitology, Czechoslovak Academy of Sciences,
Branišovská 31, 370 05 České Budějovice, Czechoslovakia
[2]Department of Zoology, University of Agricultural Sciences,
H — 8361 Keszthely, Hungary

Abstract. A sample of the 31 specimens of anuran amphibians from Papua New Guinea and Australia (Queensland), belonging to 18 species, was provided for helminthological examination by the Department of Herpetology, American Museum of Natural History in New York. The taxonomic evaluation of parasitic nematodes recovered from 6 species of hylid and ranid frogs is presented in this paper. These include: *Seuratascaris numidica* (Seurat, 1917), *Cosmocerca novaeguineae* sp. n., Cosmocercinae gen. sp. 1, Cosmocercinae gen. sp. 2, *Oxysomatium* sp., *Maxvachonia adamsoni* sp. n., *Desmognathinema papuensis* sp. n., *Spinitectus* sp., and *Rhabdias australiensis* sp. n. *C. novaeguineae* sp. n. from the intestine of *Platymantis papuensis* from Papua New Guinea differs from the closely related *C. ornata* mainly in the number and arrangement of caudal papillae in the male, longer spike-like portion of the female tail and some other features, whereas *M. adamsoni* sp. n. from the intestine of *Litoria infrafrenata* from Papua New Guinea is characterized mainly by the absence of lateral alae, number and arrangement of caudal papillae in the male, and by the shape of the female tail. *D. papuensis* sp. n. (only females available) from the intestine of *Rana grisea* from Papua New Guinea is characterized by the presence of small oesophageal teeth and a cephalic vesicle, situation of deirids and excretory pore in the region of oesophagus, and by the shape of the glandular oesophagus; the genus *Wakubitinema* Hasegawa, 1988 is considered a synonym of *Desmognathinema* and, accordingly, its type species is transferred to the latter genus as D. *toyamai* (Hasegawa, 1988) comb. n.; *Desmognathinema* is newly diagnosed. Characteristic features of *Rh. australiensis* sp. n. from the lungs of *Rana daemeli* from Australia are mainly the small size and plump shape of body and the extent of ovaries. Almost all the nematodes are briefly described and illustrated and some problems concerning their taxonomy, hosts and geographical distribution are discussed.

Despite the fact that the nematode faunae of amphibians in New Guinea and Australia are of particular interest from the viewpoint of zoogeography and animal evolution, the present knowledge of these parasites from both these geographical regions is rather poor. Until now, there are no detailed and systematic investigations from New Guinea and Australia in this respect, and most amphibian species occurring in both these regions have not yet been examined for the helminth parasites. The available data on the occurrence of parasitic nematodes in amphibians in New Guinea are those provided by Johnston (1967), Mawson (1972), Sprent (1985 a, b) and Moravec and Sey (1986), whereas those concerning the amphibian nematodes from Australia can be found in the papers by Baylis (1930), Johnston and Mawson (1941), Johnston and Simpson (1942), Inglis (1968 a, b), Mawson (1972), and Sprent (1985 a, b).

In the years 1983—1986, through the courtesy of Dr. Richard B. Zweifel, several fixed specimens of Papua New Guinea and Australian anurans belonging to 18 species were provided for helminthological examination by the Department of Herpetology, American Museum of Natural History in New York, USA. Of them, only the following species harboured parasitic nematodes: *Rana daemeli* (Steindachner), *R. grisea* van Kampen, *R. grunniens* Sonnini et Latreille, *Platymantis papuensis* Meyer, *Nyctimystes narinosa* Zweifel, *Litoria infrafrenata* (Günther), *Phrynomantis humicola* Zweifel, *Ph. stictogaster* Zweifel, and *Ph. wilhelmana* (Loveridge). Parasitic nematodes from *Phrynomantis* spp. of this material have already been dealt with in the previous authors' paper (Moravec and Sey 1986), while the systematic evaluation of those from the remaining hosts is the subject of the present study. The trematodes of the same material have been treated in the paper by Moravec and Sey (1989).

According to Frost (1985), the distribution of *Rana daemeli* is in northeast Queensland in Australia and on the south coast of New Guinea and around the north coast from Milne Bay to Huon Peninsula; the area of distribution of *Rana grisea* includes New Guinea and Ceram Isl., that of *Rana grunniens* Java, Celebes and Amboina Isl., of *Platymantis papuensis* New Guinea and surrounding islands and Bismarck Archipelago, of *Nyctimystes narinosa* only mountains in central New Guinea, and that of *Litoria infrafrenata* Cape York Peninsula, Queensland, Australia, and New Guinea, New Ireland and Bismarck Archipelago; this species was also introduced into Java.

## MATERIALS AND METHODS

The nematode specimens were collected from fixed host frogs from the collections of the Department of Herpetology, American Museum of Natural History in New York, USA. Only alimentary tracts were removed and examined for the presence of internal parasites. Then the animals were returned ot the museum. The following species of frogs were examined in this way:

Australia: *Rana daemeli* (Steidachner) (3 specimens — Cat. Nos. 54249, 54276, 54288);

Papua New Guinea: *Rana grisea* van Kampen (4 specimens — Cat. Nos. 76593, 76606, 76609), *R. grunniens* Sonnini et Latreille (1 specimen — Cat. No. 77618), *Platymantis papuensis* Meyer (2 specimens — Cat. Nos. 78076, 78078), *Litoria infrafrenata* (Günther) (1 specimen — Cat. No. 56538), *L. darlingtoni* (Loveridge) (1 specimen — Cat. No. 98885), *L. micromembrana* (Tyler) (1 specimen — Cat. No. 99558), *Nyctimystes narinosa* Zweifel (1 specimen — Cat. No. 66198), *Cophixalus cryptotympanum* Zweifel (2 specimens — Cat. Nos. 113024, 113050), *C. parkeri* Loveridge (2 specimens — Cat. Nos. 66318, 66332), *C. darlingtoni* Loveridge (2 specimens — Cat. Nos. 112805, 112809), *C. riparius* Zweifel (2 specimens — Cat. Nos. 112940, 112945), *Hylophorbus rufescens* Macleay (2 specimens — Cat. Nos. 81185, 81191), *Oreophryme anthonyi* (Boulenger) (2 specimens — Cat. Nos. 56783, 57436), *Xenobatrachus rostratus* (Méhely) (2 specimens — Cat. Nos. 76093, 76095), *Phrynomantis stictogaster* Zweifel (2 specimens — Cat. Nos. 76466, 76468), *Ph. humicola* Zweifel (2 specimens — Cat. Nos. 113592, 113615), and *Ph. wilhelmana* (Loveridge) (2 specimens — Cat. Nos. 113718, 113719). Of them, only the 9 above mentioned species proved to harbour parasitic nematodes.

The nematode specimens were killed *in situ* by formalin preservation of the hosts which were later stored in 65% ethanol. For examination, these were cleared with glycerine and *en face* views prepared according to Anderson's (1958) method. All drawings were made with the aid of a camera lucida. All materials are deposited in the helminthological collection of the Institute of Parasitology, Czechoslovak Academy of Sciences, České Budějovice. In the following account of the species encountered, measurements are given in millimetres.

## REVIEW OF SPECIES

### Fam **Ascarididae** Baird, 1853

1 *Seuratascaris numidica* (Seurat, 1917)

Syn **Porrocaecum numidicum** Seurat, 1917, **Amplicaecum brumpti** Khalil, 1926, **Amplicaecum ranae** Gupta, 1959, **Amplicaecum communis** Yuen, 1963

Host *Rana daemeli* (Steindachner) (fam Ranidae)
Localization intestine
Locality Nesbit River, Leo Creek, 450 m elevation, Queensland, Australia (17 August 1948)

Comments — Only one damaged female of this nematode was found. According to Sprent (1985 b) who revised species of this genus, there are no distinct differences among the specimens originating from Europe, South East Asia and Australian region though considerable variation in the form of their interlabial region was evident accordingly, the author recognizes only one species *S numidica*, in this genus He mentions however that it is possible that comparative observations on fresh specimens, completed with life history studies may detect more clearcut differences among the forms from different geographical regions, so that more than a single species in *Seuratascaris* may eventually be recognized

This species has already been reported from *Rana daemeli* from Australia (Queensland) by Sprent (1985 b)

### Fam **Cosmocercidae** Railliet, 1916

2 *Cosmocerca novaeguineae* sp n (Fig 1)

Type host **Platymantis papuensis** Meyer (fam Ranidae).
Localization intestine
Type locality Miliom (Torricelli Mts, 2 mi east of Lumi), 450 m elevation, Sepik Province, Papua New Guinea (24—26 July 1966)
Occurrence in both *P papuensis* specimens examined, intensity of infection 4 and 5 nematodes per frog
Deposition of types Institute of Parasitology, Czechoslovak Academy of Sciences, České Budejovice, Czechoslovakia (holotype, allotype and 7 paratypes — Cat No N-387)
Etymology The specific name of this species relates to the site of its occurrence, i e New Guinea

Description Small, whitish nematodes of fusiform body Oesophagus anteriorly with short pharynx, posteriorly with bulb provided with valvular apparatus Narrow lateral cuticular alae extending from head end nearly to mid-length of tail in female and to anal opening level in male Excretory pore at bulb level in male and in front of bulb in female

Male (1 specimen — holotype) Length of body [illegible].90, maximum width 0.218 Numerous somatic papillae present in posterior half of body Narrow lateral cuticular alae extending posteriorly to anal opening level Length of entire oesophagus 0.326 length of pharynx 0.015, of bulb 0.063, width of bulb 0.069, of anterior narrow portion of oesophagus 0.027 Distance of nerve ring from anterior extremity 0.135 of excretory pore 0.300 Well sclerotized, 0.111 long gubernaculum present spicules rudimentary weakly sclerotized length some 0.069 Five pairs of plectanes and one pair of conspicuous, large subventral papillae present anterior to cloaca, plectanes directed slightly posteriorly, papil-

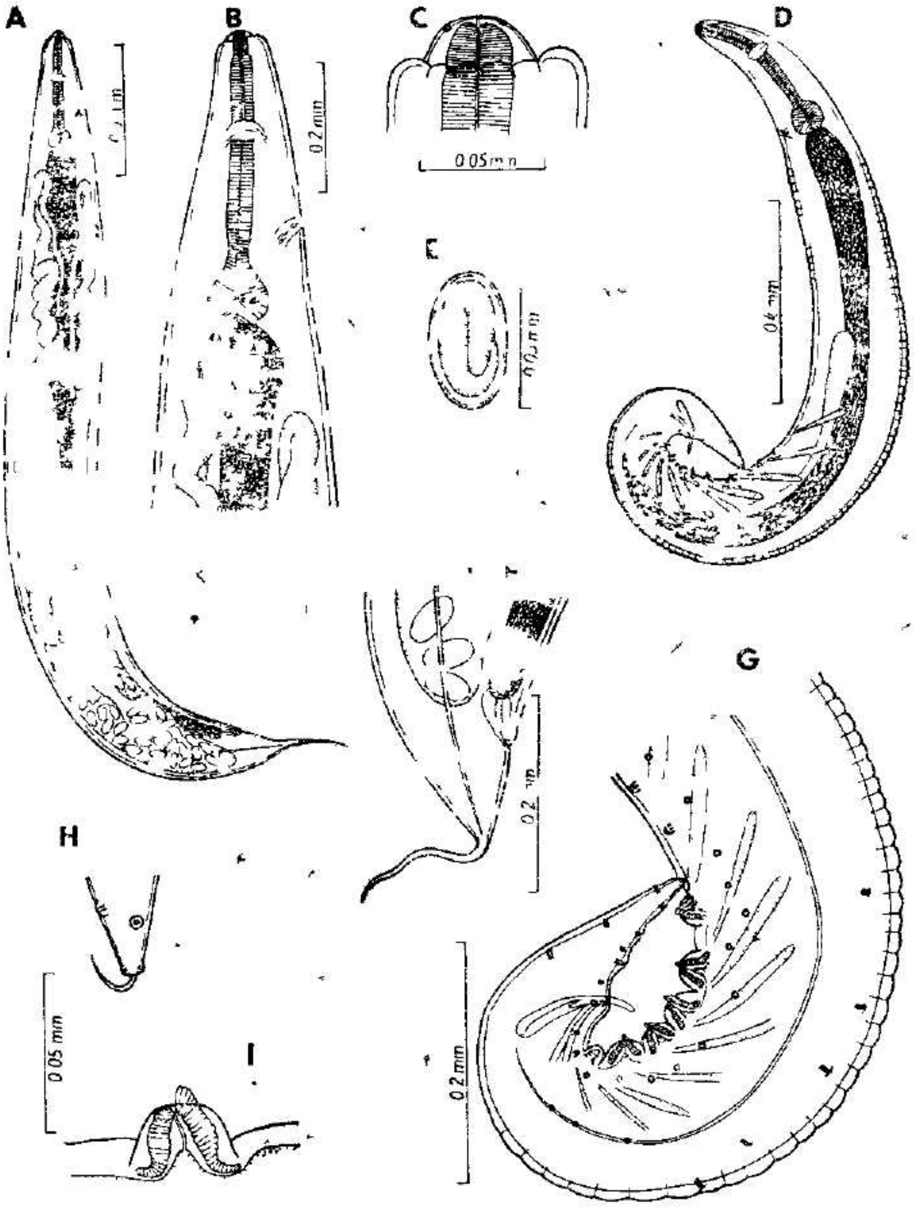


Fig 1 *Cosmocerca novaeguineae* sp n A — female, general view; B — anterior end of female, lateral view, C — anterior extremity of female, D — male, general view, E — mature egg, F — tail of female, G — tail of male; H — tail tip of male, I — plectane

la bordered on posterior side with semicircular row of minute rosette-like punctations underlying sclerotized supports conspicuous and not fused between plectanes. Oblique, paired (11 pairs) subventral muscle bands present prior to region of plectanes. Tail and caudal region with numerous small papillae indistinguishable from somatic papillae and distributed in subventral, lateral and subdorsal rows. Tail bearing altogether ten pairs of papillae; one pair of subventral papillae situated in proximal third of tail markedly larger than somatic papillae. Two pairs of small adanal ppillae present. Tail 0.144 long, conical, with terminal spike 0.015 long.

Female (8 specimens; measurements of allotype in parentheses): Length of body of gravid females 2.14—4.15 (4.15), maximum width 0.258—0.422 (0.422). Head end non-withdrawn in allotype, with distinct transverse cuticular constriction at (0.048) from anterior extremity; in all paratypes head end withdrawn (Fig. 1 B, C). Lateral cuticular alae 0.021—0.024 (0.021) wide, extending posteriorly to end of thick part of tail. Length of entire oesophagus 0.408——0.558 (0.558), that of pharynx 0.018—0.024 (0.024), that of bulb 0.090—0.111 (0.111); width of bulb 0.096—0.117 (0.117), that of anterior narrow portion of oesophagus 0.033—0.045 (0.045). Nerve ring and excretory pore 0.126—0.189 (0.189) and 0.225—0.465 (0.465), respectively, from anterior extremity. Two parallel ovaries forming coils slightly below end of oesophagus; one oviduct entering uterus in front of vulva level, another below this level. Fully developed uterus extending from ends of ovaries posteriorly to rectum level, containing numerous eggs. Vulva situated near mid-length of body, 1.12—2.24 (2.24) from anterior end of body. Vagina directed posteriorly. Eggs thin-walled, oval--shaped; fully developed, larvated eggs measuring 0.096—0.117 × 0.045—0.075 (0.102—0.117 × 0.060—0.072). Tail conical, 0.306—0.393 (0.393) long, its posterior portion 0.198—0.240 (0.240) long slender, spike-like. Papilla-like outlets of phasmids not present on tail.

Comments: — Of many species of the genus *Cosmocerca* Diesing, 1861, *C. novaeguineae* sp. n. is closest by its morphology to *C. ornata* (Dujardin, 1845). According to Baker and Vaucher (1984), the latter species, widely distributed in several zoogeographical regions (Europe, Africa and even South America), has a suite of unique morphological characters which readily permits its identification (posteriorly directed plectanes surrounded by semicircles of punctations, short spike-like point on the male tail, distribution of male caudal papillae, relatively wide lateral alae in males, female tail which is spike-like throughout most of its length). Nevertheless, the morphology of *C. novaeguineae* sp. n. exhibits, in contrast to *C. ornata*, certain distinct differences that, in our opinion, should be considered interspecific. Since *C. ornata* was originally described from Europe, the following comparison is principally based on the redescription of this species given by Moravec and Vojtková (1974) according to the specimens from European frogs.

In the new species, the female tail is smooth, without any papillae, whereas the females of *C. ornata* are noted for the presence of a pair of conspicuous papillae (outlets of phasmids) on the anterior end of the narrowed part of their tail; the spike-like portion of the female tail of *C. novaeguineae* sp. is distinctly longer than a mid-length of the tail (representing 58—65% of its entire length), while in *C. ornata* this is shorter than a half of the tail (some 39—45% of its length). The lateral alae of the new species are distinctly narrower (in females

0.021—0.024 mm versus 0.036—0.045 mm in *C. ornata*), reaching posteriorly up to the anal opening in males (only to region of plectanes in *C. ornata*) and not reaching to mid-length of the tail in females (exceeding the mid-length of the tail in *C. ornata*). The female head end of *C. novaeguineae* sp. **n.** is separated from the remaining part of the body by a transverse constriction of the cuticle, being usually posteriorly withdrawn at this site; this was not observed in *C. ornata* females. The male of *C. novaeguineae* sp. n. possesses in its preanal region, in addition to five pairs of plectanes, also a subventral pair of conspicuously large papillae situated between the most posterior pair of plectanes and the cloacal opening (these papillae are absent from *C. ornata*) and the number of pairs of postnatal papillae is only 10 in contrast to 14—16 in *C. ornata* (see Moravec and Vojtková 1974, Hartwich 1975). Both these species also differ in the size of body of gravid females: the length of body of *C. novaeguineae* females is only 2—4 mm, whereas that of *C. ornata* 5—10 mm.

It is also necessary to take into account their geographical distribution. But in this connection it is necessary to remark that even though *C. ornata* has been reported from various zoogeographical regions, it would de desirable to carry out a detailed comparison of the materials of this species, especially from the Oriental, Ethiopian and Neotropical Regions with those from Europe. Available descriptions and drawings of this species originating from these regions sometimes indicate distinct morphologcal and biometrical differences (see e.g. Baker and Vaucher 1984).

Members of the genus *Cosmocerca* have not hitherto been reported from New Guinea (see also Baker 1982) and, consequently, *C. novaeguineae* sp. n. is the first species known from New Guinea anurans.

3. Cosmocercinae gen. sp. 1

Host: ***Rana daemeli*** **(Steindachner) (fam. Ranidae).**
Localization: **intestine.**
Localities: **Nesbit River, Leo Creek, 450 m elevation (17 August 1948) and Iron Range (bank of Claudie R.), 15 m elevation (date of collection?), both Queensland, Australia.**

Description: Male unknown.

Female (8 specimens): Length of body of gravid females 3.32—3.94, maximum width 0.313—0.381. Lateral alae comparatively wide (0.030—0.033), extending from head end to level of tail, exceeding its mid-length posteriorly. Length of entire oesophagus 0.503—0.517, that of pharynx 0.021—0.024, that of bulb 0.099—0.111; width of bulb 0.102—0.120, that of anterior narrow portion of oesophagus 0.039—0.048. Nerve ring and excretory pore 0.177—0.180 and 0.367—0.394, respectively, from anterior extremity. Prodelphic. Uterus containing numerous eggs. Vulva situated near mid-length of body, 1.77—1.90 from anterior end of body. Vagina directed posteriorly. Eggs thin-walled, oval-shaped, mature (larvated) eggs measuring 0.099—0.120 × 0.066—0.072. Tail conical, 0.354—0.517 long, its posterior portion slender, spike-like, measuring 0.177—0.218. Papilla-like outlets of phasmids not present on tail.

Comments: — Only females were recovered and, therefore, their generic and specific identification is impossible. By their morphology and measurements, these nematodes are very similar to the foregoing species *Cosmocerca novaeguineae*; but in contrast to this, they are noted for the absence of a cuti-

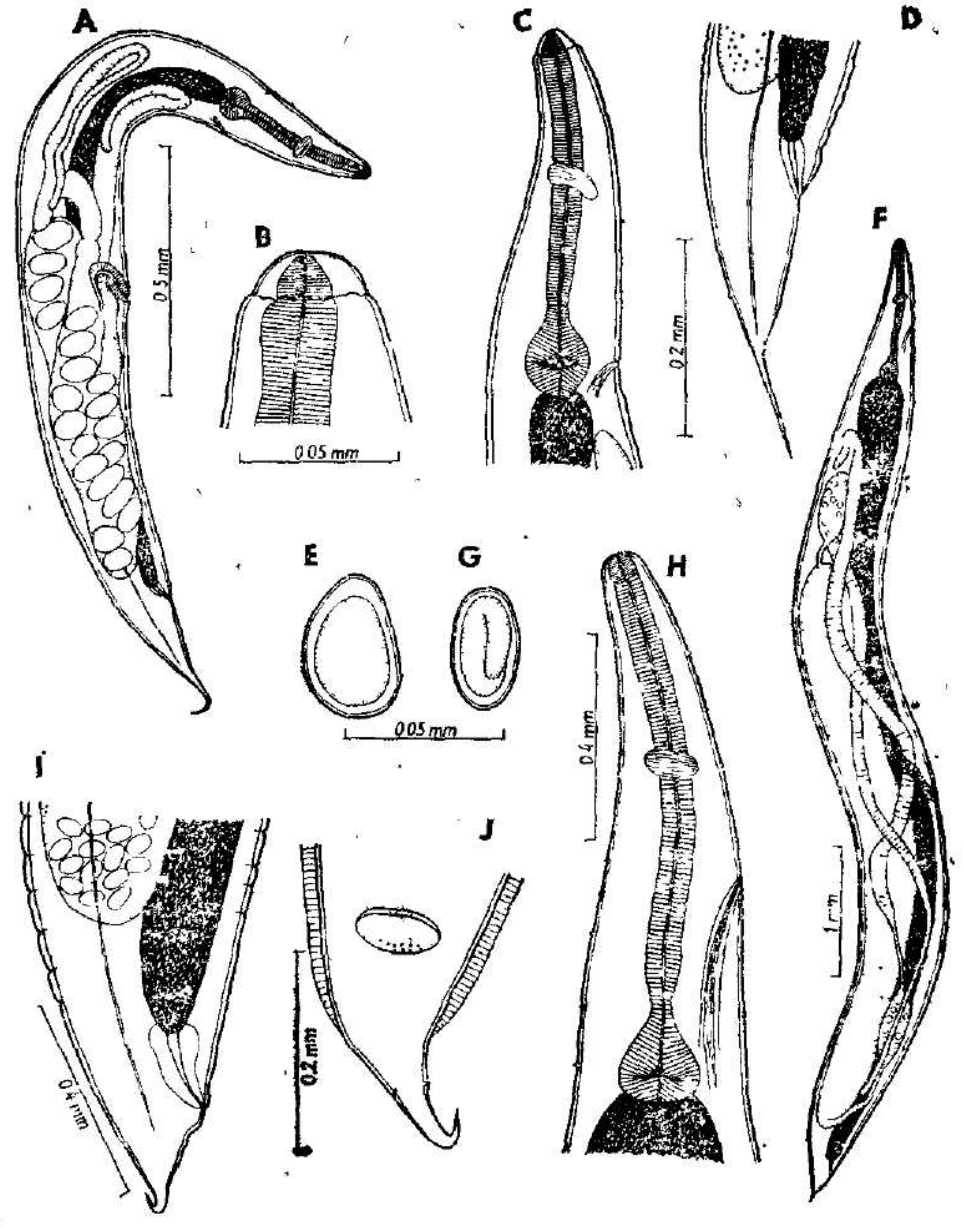


Fig. 2. A—E — Cosmocercinae gen. sp. 2 from *R. grisea* from Papua New Guinea (A — gravid female, general view; B — head end of female; C — anterior part of female body; D — tail of female; E — egg); F—J — *Oxysomatium* sp. from *N. narinosa* from Papua New Guinea (F — gravid female, general view; G — mature egg; H — anterior end of female; I — posterior part of female body, lateral view; J — tail of female, ventral view).

cular constriction on the head end, distinctly broader lateral alae (0.030—0.033 mm versus 0.021—0.024 mm), and the spike-like portion of the female tail shorter or equal to the half-length of the tail (42—50% of tail length). Since these nematodes also originated from a different geographical region from a different host species, we think they belong to a different species and possibly also a genus. Their species identification will be only possible when also males are known.

According to Baker (1982), the subfamily Cosmocercinae is reprerented in Australian anurans only by the genus *Cosmocerca* Diesing, 1861. However, out of the three *Cosmocerca* species reported from this region, *C. australiensis* Johnston et Simpson, 1942 and *C. propinqua* Johnston et Simpson, 1942, both recovered from *Limnodynastes dorsalis,* were described only from females and their appurtenance to *Cosmocerca* is doubtful (see also Skryabin et al. 1961); the morphology of their females (e.g., situation of the vulva in oesophageal region, a conspicuously long caudal spike) suggests that in both cases these might be members of *Parathelandros* Baylis, 1930. The third species, *C. limnodynastes* Johnston et Simpson, 1942, reported from the same host species, is apparently the actual member of *Cosmocerca*. However, in addition to the last named *Cosmocerca* species, also a representative of *Raillietnema* Travassos, 1925, *R. kartanum* Johnston et Mawson, 1941, has been reported from Australian frogs (*Hyla* spp., *Helioporus eyrei*); Skryabin et al. (1961) transferred this species to *Oxysomatium* Railliet et Henry, 1913, but in Inglis' (1968 a) opinion it is desirable to retain it in the genus *Raillietnema*. Also this genus belongs to Cosmocercinae.

4. Cosmocercinae gen. sp. 2 (Fig. 2 A-E)

Host: ***Rana grisea*** **van Kampen (fam. Ranidae).**
Localization: intestine.
Locality: **Okasa, 900—1400 m elevation, Eastern Highlands Province, Papua New Guinea (date of collection ?).**

Description: Male unknown.
*Female (2 specimens): Length of body 1.78—2.01, maximum width 0.177—*—0.245. Somatic papillae almost absent. Lateral alae extending from head end to level of tail, exceeding its mid-length posteriorly. Anterior extremity retracted slightly into body behind pharyngeal portion of oesophagus. Length of entire oesophagus 0.396—0.402, that of pharynx 0.018, hat of bulb 0.075; width of bulb 0.072—0.075, that of anterior narrow portion of oesophagus 0.030—0.033. Nerve ring and excretory pore 0.138—0.177 and 0.300—0.354, respectively, from anterior extremity. Prodelphic. Uterus of smaller specimen without eggs, that of larger specimen containing small number of nonembryonated eggs measuring 0.084—0.135 × 0.048—0.066. Vagina first directed anteriorly and then curving posteriorly. Tail conical, 0.276—0.285 long, its posterior portion slender, spike-like measuring 0.105—0.135 (representing 38—47% of tail length). Papilla-like outlets of phasmids not present on tail.

**Comments: — Since only females were available, their generic and specific identification was not possible. The morphology of these females is similar to that of *Cosmocerca novaeguineae,* but in contrast to this species, the spike-like portion of the tail is relatively shorter (i.e. shorter than a half-length of the tail).**

### 5. *Oxysomatium* sp. (Fig. 2 F—J)

Host: *Nyctimystes narinosa* Zweifel (fam. Hylidae).
Localization: intestine.
Locality: Kotuni (southern slope of Mt. Otto), 2100—2400 m elevation, Eastern Highlands Province, Papua New Guinea (date of collection ?).

Description: Male unknown.

Female (1 specimen): Body elongate, tapering to both ends. Length of body 8.50, maximum width 0.816. Numerous small somatic papillae present. Narrow lateral alae (width 0.018) extending from anterior third of body length up to mid-length of tail. Head end rounded, mouth elements obscured. Length of entire oesophagus 1.20, that of its narrow anterior portion 0.993, that of bulb 0.190; width of bulb 0.190, that of anterior portion of oesophagus 0.068. Nerve ring and excretory pore 0.476 and 0.762, respectively, from anterior extremity. Vulva postequatorial, 3.84 from posterior end of body. Vagina directed anteriorly. Uteri opposed, ovary of posterior uterus located anterior to vulva, terminal half of ovary of anterior uterus located posterior to vulva. Eggs thin-walled, oval-shaped; size of mature eggs containing larva 0.075—0.087 × 0.039—0.048. Tail conical, 0.272 long, spike-like at tip; two small lateral papillae (outlets of phasmids) present below mid-length of tail.

Comments: — Since *Oxysomatium* Railliet et Henry, 1916 is the only genus within the family Cosmocercidae the female of which are amphidelphic (see Chabaud 1978, Baker 1980, 1982), this nematode can be assigned to this genus. According to the revisional work of Baker (1980), at present the genus *Oxysomatium* includes only three species occurring in Europe, Palaearctic Asia and North Africa. Therefore, it is highly probable that the specimen of the present material represents a new, hitherto undescribed species. Unfortunately, the specific morphological characters of *Oxysomatium* species are found in males, whereas females are rather uniform in their morphology. Consequently, we refrain from describing this nematode as a new species.

### 6. *Maxvachonia adamsoni* sp. n. (Fig. 3)

**Type host**: ***Litoria infrafrenata*** **(Günther) (fam. Hylidae).**
Localization: intestine.
**Type locality**: **Moi Biri Bay, Baiawa, sea level, Papua New Guinea (date of collection ?).**
Deposition of types: Institute of Parasitology, Czechoslovak Academy of Sciences, České Budějovice, Czechoslovakia (holotype, allotype, paratype — Cat. No. N-449)
Etymology: The new species has been named in honour of Dr. Martin L. Adamson, Department of Zoology, the University of British Columbia in Vancouver, Canada, who contributed greatly to the knowledge of nematode parasites of amphibians.

Description: Body cylindrical, tapering to both ends. Head end rounded, mouth elements not studied. No somatic papillae present. Lateral alae absent. Nerve ring encircling oesophagus approximately at border of its first and second thirds; oesophagus forming long anterior cylindrical portion, isthmus and bulb armed with three sclerotized valves; pharynx indistinct. Excretory pore in front of bulb. Male much smaller than female.

Male (1 specimen — holotype): Body 2.45 long, with maximum width 0.231. Cuticle smooth, only near posterior end with very fine transverse striation.

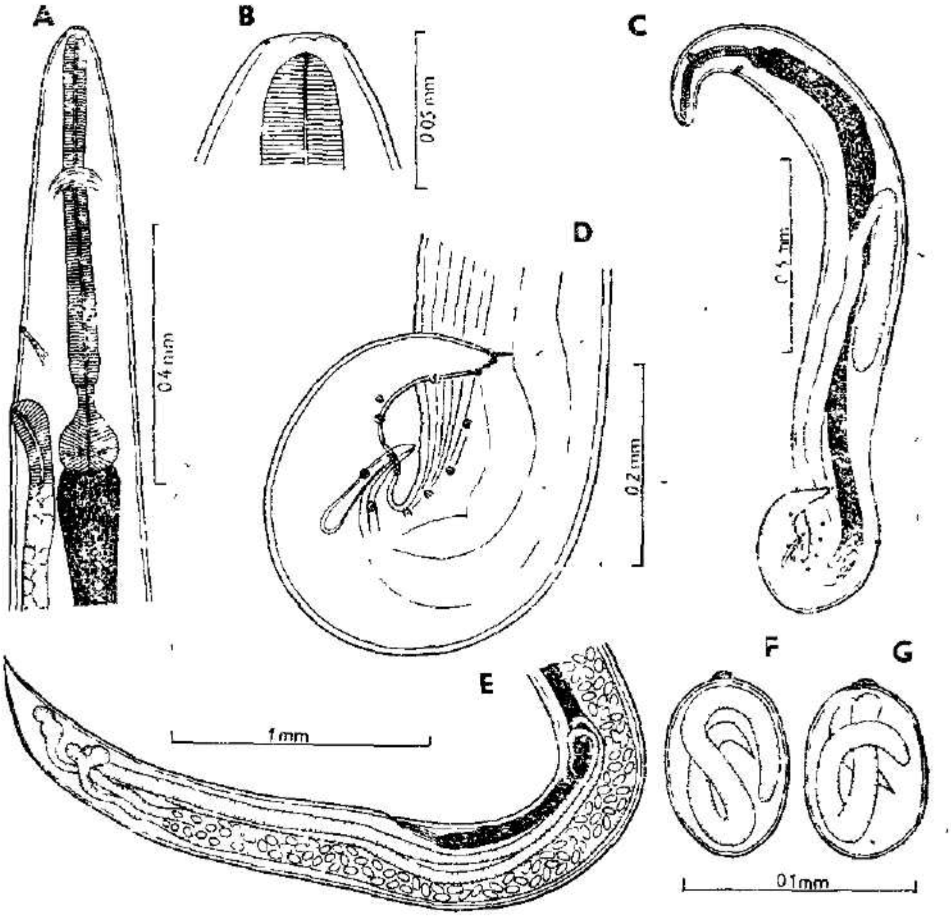


**Fig. 3.** ***Maxvachonia adamsoni*** **sp. n. A — anterior part of female body; B — head end of female; C — male, general view; D — tail of male; E — tail of female; F, G — mature egg.**

Length of entire oesophagus 0.402; length of its anterior cylindrical portion 0.300, of isthmus 0.054, of bulb 0.060; width of anterior cylindrical portion of oesophagus 0.030, of isthmus 0.024, of bulb 0.066. Nerve ring and excretory pore 0.204 and 0.300, respectively, from anterior extremity. Testis situated in middle of their body length. Posterior end of body ventrally bent. Caudal papillae numerous: 5 pairs of subventral preanal papillae, 1 pair of subventral adanal papillae, 2 pairs of circumanal papillae, and 6 pairs of postnatal papillae present. Well sclerotized 0.135 long gubernaculum present; spicules short, 0.120 long, less sclerotized than gubernaculum. Cuticle of ventral precloacal region strengthened, with a number of longitudinal grooves. Tail conical, 0.258 long, tapeirng in sharp point.

Female (2 specimens; measurements of allotype in parentheses): Length of body of gravid females 8.68—9.48 (9.48), maximum width 0.367—0.408 (0.367). Cuticle with longitudinal striation, in posterior portion also with very fine transverse striation. Length of entire oesophagus 0.748—0.775 (0.748); length of its anterior cylindrical portion 0.598—0.612 (0.598), of isthmus 0.054—0.068 (0.068), of bulb 0.082—0.095 (0.082); width of anterior cylindrical portion of oesophagus 0.041 (0.041), of isthmus 0.027 (0.027), of bulb 0.095—0.109 (0.095). Nerve ring and excretory pore 0.245—0.258 (0.245) and 0.476—0.530 (0.530), respectively, from anterior extremity. Vulva situated at isthmus level, 0.585—0.653 (0.653) from anterior extremity; ovejector including short sphincter portion and rather long cylindrical portion. Uterus extending posteriorly into tail, containing numerous eggs. Two parallel ovaries situated in posterior part of body (distance of their anterior ends from posterior end of body 3.06—3.13 (3.13), extending into tail; most posterior part of genital organs represented by two conspicuous seminal receptacles. Mature eggs oval-shaped, thin-walled, larvated, size 0.060—0.078 × 0.045—0.057 (0.072—0.078 × 0.054—0.057). One pole of egg provided with small protuberance; filaments not observed, but their presence cannot be excluded (eggs observed only inside cleared nematode body). Tail unusually long (representing 20—24 (20) % of body length), with conical, sharply pointed tip; length of tail 1.86—2.04 (1.86).

Comments: — The genus *Maxvachonia* Chabaud et Brygoo, 1960 includes sveral closely related species parasitic in reptiles and amphibians in Madagascar, Australia and New Guinea. Its type species, *M. dimorpha* Chabaud et Brygoo, 1960, has been recorded from chameleons and other species of lizards from Madagascar and a nearby small island, Nossi-Bé (Cabaud and Brygoo 1960, Chabaud et al. 1964, Caballero 1968), whereas four other congeneric species are known to occur in the region of Australia and New Guinea. Of them, *M. chabaudi* Mawson, 1972 and *M. brygooi* Mawson, 1972 are the parasites of lizards (skinks and agamids) in Australia, *M. flindersi* (Johnston et Mawson, 1941) occurs in frogs and a toad in Australia and *M. ewersi* Mawson 1972 is known from the frog *Litoria nasuta* in New Guinea (Johnston and Mawson 1941, Inglis 1968, Mawson 1972).

In the absence of lateral alae in the female, *M. adamsoni* sp. n. resembles only *M. dimorpha* and *M. brygooi;* all other species possess well developed alae on the anterior part of the body. However, in contrast to the new species, *M. dimorpha* possesses only 4 pairs of preanal and 1 pair of adanal papillae in the male (5 pairs of preanals and 1 pair of adanals in *M. adamsoni*) and the shape of the seminal receptacle in females of both *M. dimorpha* and *M. brygooi* is different from that in *M. adamsoni* sp. n. Moreover, the new species differs from these two congeners also in host types (reptiles versus amphibians) and distribution (Madagascar and Australia versus New Guinea).

From the two *Maxvachonia* species known from amphibians, *M. adamsoni* sp. n. differs as follows: While both *M. flindersi* and *M. ewersi* possess well developed lateral alae in the female, these are absent from females of *M. adamsoni* sp. n. There are 5 pairs of subventral preanal papillae present in the male of the new species, whereas only 2 pairs of subventral preanal papillae are present in *M. ewersi* and 2 pairs of subventral preanal papillae and 3 pairs arranged in a triangle lying at the level of the cloacal opening are present in *M. flidersi* (see Inglis 1968a, Mawson 1972). Moreover, *M. ewersi*, the only *Maxvachonia* species reported from New Guinea, differs from the new species also in the shape of the posterior end of body in the female (rounded versus sharply pointed), relative size of spicules to the gubernaculum (spicules distinctly longer than gubernaculum versus spicules of about the same length as gubernaculum), and some other morphological features.

In 1938, Kreis (1938) described a new nematode species from female specimens collected in the stomach and intestine of *Gecko vittatus* from Makira, Solomon Islands, which he had named *Typhlonema salomonis;* this species has been the only representative of the genus *Typhlonema* Kreis, 1938. But Chabaud (1978) correctly pointed out that *Typhlonema* was of uncertain systematic position and could not be classified in the present nematode system because the male is unknown. Kreis did not see the anus and, therefore, Chabaud (1978) mentions that if it should prove to be markedly anterior in position, one might suggest that *Typhlonema* and *Maxvachonia* are related. In our opinion, it may well be that the two genera are identical and if *T. salomonis* and *Maxyachonia* spp. prove to be congeneric, then *Maxvachonia* will become only a junior synonym of *Typhlonema.*

Unfortunately, the description of *Typhlonema salomonis* is inadequate and, accordingly, its comparison with *Maxvachonia adamsoni* sp. n. is difficult. Nevertheless, for the time being, these two species can be distinguished by their host types (amphibians compared to reptiles) and geographical distribution (Papua Nw Guinea versus Solomon Islands).

### Fam. Quimperiidae Gendre, 1928

### 7. *Desmognathiema papuensis* sp. n. (Fig. 4)

Type host: *Rana grisea* van Kampen (fam. Ranidae).
Localization: intestine.
Type locality: Okasa, 900—1400 m elevation, Eastern Highlands Province, Papua New Guinea. Another locality: Igindi, Eastern Highlands Prov., Papua New Guinea (22 November 1964).
Occurrence: 2 adult specimens recovered from the only *R. grisea* from Okasa and 3 larvae from the only frog of the same species examined from Igindi.
Depositon of types: Institute of Parasitology, Czechoslovak Academy of Sciences, České Budějovice, Czechoslovakia (holotype, paratype — Cat. No. N-386).

Description: Male unknown.

**Female** (2 specimens; measurements of holotype in parentheses): Body long, slender, tapering to both ends; cuticle thin, smooth. Length of body 20.81—21.76 (21.76), maximum width 0.503—0.558 (0.503). Body wall of cleared specimens not well transparent. Head end rounded, with distinct inflation of cuticle 0.033 (0.033) long and 0.075 (0.075) wide. Cephalic papillae (exact number not determined) and amphids pedunculate. Mouth triangular, buccal cavity poorly developed. Pharynx distinct, relatively long, measuring 0.109 (0.109) in length and 0.054 (0.054) in width, with three small anterior pharyngeal teeth. Oesophagus distinctly divided into anterior muscular and posterior glandular portions. Muscular portion thinner but longer than glandular one; anterior end of glandular portion distinctly narrower than its posterior end; middle of this portion markedly constricted. Length of muscular portion of oesophagus 0.856—1.040 (0.856), its width 0.054 (0.054). Length of glandular portion of oesophagus 0.571—0.598 (0.571), length of its anterior narrower part 0.299—0.340 (0.299), of

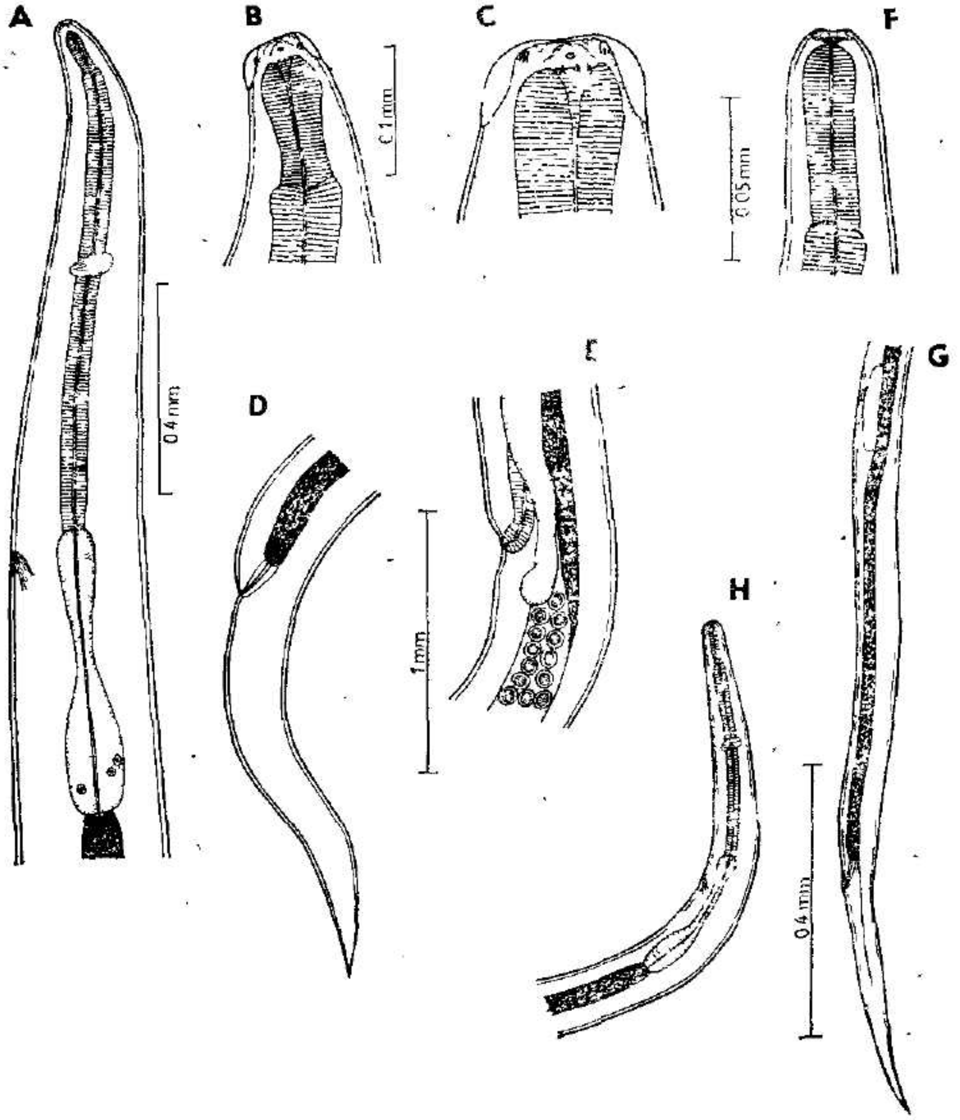


Fig. 4. *Desmognathinema papuensis* sp. n. A—E — female (A — anterior part of body, lateral view; B — head end; C — same, higher magnification; D — tail; E — region of vulva); F—H — third-stage larva (F — head end; G — posterior part of body; H — anterior part of body).

its broader posterior part 0.272 (0.272); width of gladular oesophagus at its anterior and posterior ends 0.081—0.095 (0.095) and 0.122—0.163 (0.163), respectively. Overall length of oesophagus including pharynx 1.37—1.62 (1.37). Nerve ring encircling muscular portion of oesophagus approximately at its mid-length 0.598—0.612 (0.612) from anterior end of body. Deirids very small, situated slightly in front of anterior end of glandular oesophagus, 0.775—0.938 (0.938) from anterior extremity. Excretory pore at level of anterior end of glandular oesophagus, 0.966—1.102 (1.102) from anterior end of body. Lateral alae absent. Vulva slightly depressed, postequatorial, 8.02—9.11 (8.02) from posterior extremity. Vagina short, directed anteriorly. Uterus amphidelphic, containing almost spherical, thin-walled, nonembryonated eggs some 0.042—0.051 in diameter; eggs absent in paratype female. Tail rather long, measuring 1.44—1.67 (1.67), with sharply pointed tip; tail representing 6—8 (8) % of whole body length.

Third-stage larva (3 specimens): Body slender, 1.55—1.80 long and 0.054 wide. Cuticle smooth. Head cuticular inflation not yet developed. Cephalic papillae sessile. Small buccal cavity present. Entire oesophagus 0.422—0.490 long; length of pharynx 0.048—0.051, of its anterior muscular portion 0.216—0.228, of glandular portion 0.189—0.216. Middle part of glandular oesophagus markedly narrowed. Distance of nerve ring from anterior extremity 0.162, of deirids 0.276—0.282, of excretory pore 0.285—0.309. Oval genital primordium situated 0.476—0.598 from posterior end of body. Tail conical, slender, 0.204—0.249 long, with posterior end tapering in sharp point. Very narrow lateral alae extending from head region to mid-length of tail present.

Comments: — In 1987, Baker et al. (1987) established a new monotypic quimperiid genus *Desmognathinema* to accommodate their newly described nematode species *D. nanthalacnsis*, a parasite of the salamander*Desmognathus quadramaculatus* in the USA. Next year, Hasegawa (1988) erected another morphologically close genus *Wakubitinema*, with the only species *W. toyamai* Hasegawa, 1988 from the relict frog *Rana namiyei* in Okinawa Island in Japan, that the author had differentiated from *Desmognathinema* mainly by the postoesophageal position of the excretory pore and deirids and by the presence of pharyngeal teeth.

In possessing small pharyngeal teeth and in having the excretory pore and deirids situated near the junction of the muscular and glandular portions of oesophagus, the nematodes of the present material represent an interlink between the two above mentioned genera. However, in our opinion, the features used by Hasegawa (1988) to separate *Wakubitinema* from *Desmognathima* have not been sufficient as it is indicated by the present finding and, consequently, we consider *Wakubitinema* Hasegawa, 1988 to be a junior synonym of *Desmognathinema* Baker, Goater et Esch, 1987; accordingly, *W. toyamai* should be transferred to the latter genus as *Desmognathinema toyamai* (Hasegawa, 1988) comb. n. The diagnosis of *Desmognathinema* should be modified as follows:

*Quimperiidae, Quimperiinae. Cephalic vesicle moderately developed or absent, cervical alae lacking; mouth triangular, buccal cavity small; small oesophageal teeth present or absent; oesophagus elongate and divided into glandular posterior portion and muscular anterior portion with distinct anterior pharyngeal part; caudal papillae in males all ventral or subventral in position; oblique muscle bands in preanal region of male present but not forming pseudosucker. Intestinal parasites of amphibians.*

Type species: *D. nantahalaensis* Baker, Goater et Esch, 1987.

It follows from the above discussion that at present the genus *Desmognathinema* is represented only by two species, *D. nantahalaensis* and *D. toyamai*. Even though the present material consists only of females, their morphology explicitly shows they belong to this genus; moreover, distinct morphological differences against both the above mentioned species indicate that the nematodes from New Guinea are representing a new, hitherto undescribed species.

The morphology of males usually provides much more conspicuous interspecific differences than that of females but, in this case, the females of *D. papuensis* sp. n. can be differentiated from those of the both previously described species on the basis of the following features: In contrast to *D. papuensis* sp. n., there are no pharyngeal teeth in *D. nantahalaensis*, the cephalic vesicle is not developed, the body cuticle on the anterior end is conspicuously irregularly thickened, and the size of the female body is smaller (body length 8—17 mm versus 21—22 mm).

*W. toyamai* differs from the new species mainly in the postoesophageal position of the excretory pore and deirids, markedly short pharynx (0.043—0.063 mm versus 0.109 mm), distinctly smaller cephalic vesicle, and relatively shorter tail (length ratio of tail and whole body length 1 : 21—26 versus 1 : 13—14 in *D. papuensis*). From both species, *D. nantahalaensis* and *D. toyamai*, the new species differs also in the shape of the glandular oesophagus, which is markedly narrowed in its middle part. It is necessary to take into account also the geographical distribution of these species and their host types: While *D. nantahalaensis* is a parasite of the salamander in North America and *D. toyamai* is known from the endemic frog species in Japan, *D. papuensis* sp. n. parasitizes the frog *Rana grisea* that is distributed only in New Guinea and Ceram Island in Indonesia (see Frost 1985).

### Fam. Cystidicolidae Skrjabin, 1946

8. *Spinitectus* sp. (Fig. 5 F—G)

Host: *Rana grunniens* Sonnini et Latreille (fam. Ranidae).
Localization: intestine.
Locality: Ambunti, 50—150 m elevation, Sepik Province, Papua New Guinea (date of collection ?).

Description of female (2 specimens): Small, whitish nematodes; length of body 4.45—4.83, maximum width 0.204—0.258. Head end rounded, posterior end pointed. Cuticle provided with small, posteriorly directed spines arranged in transverse rings; total number of rings about 200, of which 6 on tail. Some rings incomplete, mainly in posterior part of body. First two rings close to each other. First 6 rings of spines somewhat elevating, their spines being largest (maximum length of spines 0.012—0.015); size of spines gradually decreasing in posterior direction. Some 40 spines present in anterior rings. Distance of first ring of spines from anterior extremity 0.090—0.117. Mouth formed by two small lateral pseudolabia, mouth papillae indistinct. Vestibule, including anterior funnel-shaped prostom, 0.051—0.060 long; length of prostom 0.015—0.018, its width 0.021. Length of muscular oesophagus (0.336—0.474, that of glandular oesophagus 1.08—1.16. Distance of nerve ring from anterior extremity 0.195—0.216, that of excretory pore 0.240—0.270, latter opening between fourth and fifth rings of spines. Vulva situated 0.297—0.390 from posterior extremity and 0.225—0.330 from anal opening. Muscular vagina directed anteriorly. Uterus containing only immature eggs. Length of conical tail 0.072—0.081.

Comments: — The morphology of the recovered females shows a considerable resemblance to the species *S. ranae* Morishita, 1926 that is known from frogs in Japan, China and Vietnam. But in view of the fact that the taxonomy of *Spinitectus* species is mostly based on the male morphology and, moreover, the present material originates from a different geographical region, we refrain from assigning the present specimens to this species, designating them only as *Spinitectus* sp. Most representatives of the genus *Spinitectus*, including now more that 50 species, are the parasites of fishes, only few are known from amphibians. However, some species were recorded from the hosts belonging to both vertebrate classes.

### Fam. Rhabdiasidae Railliet, 1916

9. *Rhabdias australiensis* sp. n. (Fig. 5 A—E)

Type host: ***Rana daemeli*** **(Steindachner) (fam. Ranidae).**
Localization: **lungs.**
Type locality: **Peach River, 240 m elevation, Queensland, Australia (12 July 1946).**
Deposition of type: **Institute of Parasitology, Czechoslovak Academy of Sciences, České Budějovice, Czechoslovakia (holotype — Cat. No. N-450).**
Etymology: **The specific name of this species relates to the country of its origin.**

Description (1 specimen): Small nematode with anterior half of body distinctly narrower than posterior one; maximum width of body in some distance in front of anal opening. Epicuticle markedly inflated only in caudal region, forming a number of irregular folds there; in anterior half of body epicuticle forming only a low, almost smooth layer. Length of body 3.55, its maximum width 0.340, width at level of posterior end of oesophagus 0.177. Head end rounded, without distinct mouth papillae in lateral view; mouth somewhat depressed. Buccal capsule small, thin-walled, 0.006 long and 0.009 wide. Oesophagus muscular, being somewhat expanded only at its posterior portion; length of oesophagus 0.449, its maximum width 0.063. Length of oesophagus representing 13% of body length. Nerve ring and excretory pore 0.177 and 0.243, respectively, from anterior extremity. Vulva postequatorial, 1.43 from posterior end of body (distance of vulva from anterior extremity representing 60% of body length). Uterus containing numerous oval, thin-walled, larvated eggs; size of eggs 0.096—0.105 × 0.036—0.051. Anterior ovary extending posteriorly far below vulva level, reaching almost to caudal region; posterior ovary confined to posterior region of body. Tail conical, 0.225 long, ending in sharp cuticular point.

Comments: — The taxonomy of the genus *Rhabdias* Stiles et Hassal, 1905 is highly problematic because of the uniformity in the morphology of parasitic forms on which the descriptions of most species are based; accordingly, in addition to morphological features, it is necessary to consider also other important characters, especially the geographical distribution, host specificity and ecological and physiological peculiarities of species (see e.g. Baker 1978, Rausch et al. 1984). At present the genus *Rhabdias* includes a number of species parasitizing mainly the lungs of amphibians and reptiles.

Although only a single specimen from *Rana daemeli* has been available, its morphology seems to be considerably different from that of other species. It mainly concerns the shape of body (short, plump nematode with maximum width in the postvulvar part of body), situation and extent of ovaries, and the

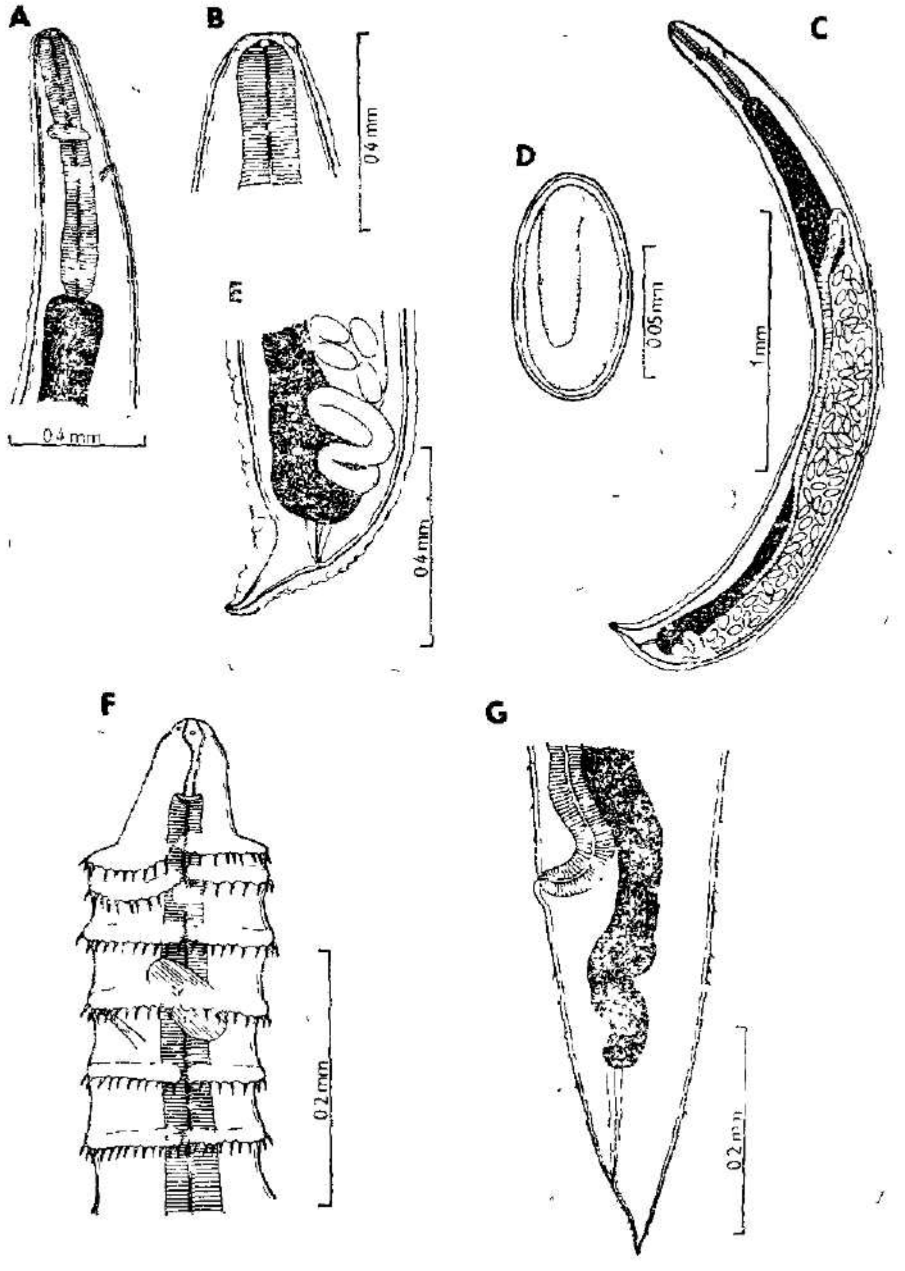


Fig. 5. A—E — *Rhabdias australiensis* sp. n. — parasitic form (A — anterior part of body; B — head end; C — general view; D — egg; E — tail); F—G — *Spinitectus* sp. from *R. grunniens* from Papua New Guinea — female (F — anterior end of body; G — posterior end of body).

size of the buccal capsule; by these features it resembles only the nematodes recently recorded from the microhylid frog *Gastrophryne carolinensis* from the south of the USA (unpublished), representing probably a new, undescribed species. Of the known species parasitizing amphibians, *R. australiensis* sp. n. seems to be closest to the recently etablished species *R. bermani* R. Rausch, V. Rausch et Atrashkevich, 1984, which was described from *Hynobius keyserlingi* (= *Salamandrella keyserlingii*) from Siberia (USSR); the posterior part of the body of both species is broad and the anterior ovary extends posteriorly far below the vulva level. Nevertheless, both the species distinctly differ from each other in some features. In comparison with the new species, the body of *R. bermani* is substantially longer (6.1—10.7 mm versus 3.6 mm) and less plump (ratio of the length of body to its width 1 : 20.6—23.3 versus 1 : 10.4), attaining its maximum width in the vulva region (in postvulvar part of body in *R. australiensis*), the buccal capsule is distinctly larger (length 0.023—0.060 mm versus 0.006 mm), and the anterior ovary does not extend into the postvulvar region as far as in the new species; on the contrary, the posterior ovary extends by its anterior end to the prevulvar part of the body (posterior ovary of *R. australiensis* is considerably reduced, forming only a small coil situated near the posterior end of the intestine). Both these species differ also in the shape of the oesophagus, host types and the geographical distribution.

The genus *Rhabdias* has hitherto been represented in Australia by the only species *R. hylae* Johnston et Simpson, 1942 from frogs (*Hyla*, *Limnodynastes*) (see Yamaguti 1961). This species differs distinctly from *R. australiensis* sp. n in the position of the vulva (preequatorial versus distinctly postequatorial), character of ovaries (e.g., anterior ovary by far not reaching posteriorly to caudal region of body compared to anterior ovary reaching posteriorly almost to caudal region in *R. australiensis*), size of the body and its shape (length of body 6.5—7.8 mm versus 3.6 mm), size of eggs (0.055 × 0.010 mm versus 0.096—0.105 × 0.036—0.051 mm) and by some other features. Moreover, both these species differ in their host types (Hylidae and Myobatrachidae versus Ranidae).

## Acknowledgements

**The authors wish to express their gratitude to Dr. Richard C. Zweifel of the American Museum of Natural History, New York, for his kindness in providing Papua New Guinea and Australian frog specimens for study.**

## REFERENCES

Anderson R. C., 1958: Méthode pour l'examen des nématodes en vue apicale. *Ann. Parasit. Hum. Comp.*, *33*: 171—172

Baker M. R., 1978: Morphology and taxonomy of Rhabdias spp. (Nematoda: Rhabdiasidae) from reptiles and amphibians of Southern Ontario. *Canad. J. Zool.*, 56: 2127—2141.

Baker M. R., 1980: A revision of the genus Oxysomatium Railliet & Henry, 1916 (Nematoda, Cosmocercidae). *Bull. Mus. natn. Hist. nat., Paris*, 4e sér., 2: 707—718.

Baker M. R., 1982: Nematode parasites of frogs. In: Deuxième Symposium sur la Spécificité Parasitaire des Parasites de Vertébrés, 13—17 avril 1981. *Mem. Mus. Natl. Hist. Nat., Ser. A, Paris*, 123: 265—270.

Baker M. R., Goater, T. M., Esch, G. W, 1987: Descriptions of three nematode parasites of salamanders (Plethodontidae: Desmognathinae) from the southeastern United States. *Proc. Helm. Soc. Wash.*, 54: 15—23.

Baker M. R., Vaucher, C., 1984: Parasitic helminths from Paraguay VI: Cosmocerca Diesign, 1861 (Nematoda: Cosmocercoidea) from frogs. *Revue suisse Zool.*, 91: 925—934.

Baylis H. A., 1930: Some Heterakidae and Oxyuridae (Nematoda) from Queensland. *Ann. Mag. Nat. Hist., Ser. 10*, 5: 354—366.

Caballero G. R., 1968: Contributions à la connaissance des nématodes de sauriens malgaches. *Ann. Parasit. Hum. Comp.*, 43: 353—380.

Chabaud A. G., 1978: Keys to genera of the superfamilies Cosmocercoidea, Seuratoidea, Heterakoidea and Subuluroidea. CIH Keys to the nematode parasites of vertebrates 6. Commonwealth Agricult. Bureaux, Farnham Royal, Bucks, 71 pp.

Chabaud A. G., Brygoo, E. R., 1960: Nématodes parasites de caméléons malgaches 1. *Mém. Inst. Scient. Madagascar, Sér. A*, 14: 125—159.

Chabaud A. G., Caballero, G. R., Brygoo, E. R., 1964: Affinités entre les genres Skrabinelazia (Ascaridida, Seuratoidea) et Maxvachonia (Ascaridida, Cosmocercoidea). *Bull. Mus. Nat. Hist. Nat., Paris*, 36: 844—848.

Frost D. F. (Ed.), 1985: Amphibian species of the world. A taxonomic and geographical reference. Joint Venture of Allen Press, Inc. and The Association of Systematics Collections, Lawrence, Kansas, USA, 732 pp.

Hasegawa H., 1988: Wakubitinema toyamai n. gen and n. sp. (Nematoda: Seuratoidea: Quimperiidae) from the intestine of Rana (Limnonectes) namiyei (Amphibia: Ranidae) on Okinawa Island, Japan. *J. Parasit.* 74: 332—335.

Inglis W. G., 1968a: Nematodes parasitic in Western Australian frogs. *Bull. Brit. Mus. (Nat. Hist.), Zool.*, 16: 163—183.

Inglis W. G., 1968b: Allopatric speciation in the nematode parasites of frogs in southern Western Australia. *J. Zool., London*, 156: 405—413.

Johnston M. R. L., 1967: Icosiella papuensis n. sp. and Ochoterenella papuensis n. sp. (Nematoda: Filarioidea), from a New Guinea frog, Cornufer papuensis. *J. Helminthol.*, 41: 45—54.

Johnston T. H., Mawson, P. M., 1941: Some nematodes from Kangaroo Island, South Australia. *Rec. S. Aust. Mus., Adelaide*, 7: 145—148.

Johnston T. H., Simpson, E. R., 1942: Some nematodes from Australian frogs. *Trans. Roy. Soc. S. Austr.*, 66: 172—179.

Kreis H. A., 1938: Beiträge zur Kenntnis parasitischer Nematoden. VIII. Neue parasitische Nematoden aus dem Naturhistorischen Museum Basel. *Zbl. Bakt. Parasitenk. Infectionskrank. Hyg., I*, 142: 329—352.

Mawson P. M., 1972: The nematode genus Maxvachonia (Oxyurata: Cosmocercidae) in Australian reptiles and frogs. *Trans Roy. Soc. S. Austr.*, 96: 101—108.

Moravec F., Sey, O., 1986: Three new nematode species from Phrynomantis spp. (Amphibia: Microhylidae) from Papua New Guinea. *Folia parasitol.* 33: 343—351.

Moravec F., Sey, O., 1989: Some amphibian trematodes from Vietnam and Papue New Guinea. *Věst. čs. Společ. zool.*, 53: 265—279.

Moravec F., Vojtková, L., 1974: Zur Kenntnis der Nematoden der Gattung Cosmocerca Diesing, 1861 in den Amphibien der ČSSR. *Folia Fac. Sci. Nat. Univ. Purk. Brunensis* 15: 53—66.

Rausch R. L., Rausch, V. R., Atrashkevich, G. I., 1984: Rhabdias barmani sp. n. (Nematoda, Rhabdiasidae) from a salamander Hynobius keyserlingi in the Soviet Far Eeast. *Zool. zhur.*, 63: 1297—1304. (In Russian, Engl. summary.)

Skryabin K. I., Shikhobalova, N. P., Lagodovskaya, E. A., 1961: Oxyurata of animals and man. Part 2. Osnovy nematodologii 10. Publ. House of Acad. Sci. of USSR, Moscow, 499 pp. (In Russian.)

Sprent J. F. A., 1985a: Ascaridoid nematodes of amphibians and reptiles: Orneoascaris. *Ann. Parasit. Hum. Comp.*, 60: 33—55.

Sprent J. F. A., 1985b: Ascaridoid nematodes of amphibians and reptiles: Seuratascaris n. g. *Ann. Parasit. Hum. Comp.*, 60: 231—246.

Yamaguti S., 1961: The nematodes of vertebrates, Parts I, II. Systema Helminthum III. Interscience Publishers, New York — London, 1261 pp.

Received April 21, 1989; accepted June 7, 1990

*Acta Soc. Zool. Bohemoslov.*, **54** : 287–304, 1990
ISSN 0862-5247

# CESTODES OF FISHES FROM MONGOLIA

Tomáš SCHOLZ & Radim ERGENS

**Institute of Parasitology, Czechoslovak Academy of Sciences,**
**Branišovská 31, 370 05 České Budějovice, Czechoslovakia**

**Abstract.** Within systematic evaluation of helminths from fishes collected in Mongolia in 1966, a total of 17 tapeworm species (Cestoda) were found. Of these, 12 species were recorded in Mongolia for the first time: *Caryophyllaeides fennica*, *C. ergensi*, ?*Breviscolex orientalis*, *Triaenophorus nodulosus*, *Eubothrium salvelini*, *Fissurobothrium unicum*, *Ligula intestinalis* larv., *Proteocephalus neglectus*, *P. percae*, *Gangesia sp.*, *Paradilepis scolecina* larv., and *Valipora campylancristrota* larv. The findings include several new host records.

Only little information is available about fish cestodes occurring in the Mongolian territory (Pronin 1974, Pronin et al. 1979, Anikieva et al. 1987, Pronina and Pronin 1988). The above mentioned authors collected four following cestode species from the fishes of Mongolia: *Cyathocephalus truncatus*, *Diphyllobothrium dendriticum* larv., *Proteocephalus thymalli* and *P. torulosus*.

This paper, following until now presented results of the Mongolian-Czechoslovak ichthyoparasitological expedition in 1966 (see, e.g., Ergens and Dulmaa 1967, 1968, Moravec and Ergens 1970), comprises a systematic evaluation of cestodes found in 22 of 34 examined fish species from the territory of Mongolia.

## MATERIAL AND METHODS

Fishes were angled and examined by a routine helminthological dissection either immediately or after their transfer in the Institute of Biology, Mongolian Academy of Sciences, in Ulan Bator. The cestodes were fixed in 4 % formalin, with the exception of specimens of the genus *Triaenophorus* Rudolphi, 1793. Tapeworms were stained with Schuberg's carmine with the exception of plerocercoids of the genus *Ligula* Bloch, 1792 and then mounted in Canada balsam. On the basis of the agreement between the Czechoslovak Academy of Sciences and the Mongolian Academy of Sciences, a part of collected worms was left in the Institute of Biology, Mongolian Academy of Sciences. The rest of the material, the systematic evaluation of which is presented, is deposited in the helminthological collection of the Institute of Parasitology, Czechoslovak Academy of Sciences, in České Budějovice. The only reference specimen of the cestode *Fissurobothrium unicum* Roitman, 1965 is deposited in the collection of the Institute of Zoology, Academy of Sciences of the USSR, Leningrad. A survey of infected fishes and localities is presented in Table 1. All measurements are in millimetres.

## SURVEY OF SPECIES

**(Day and month of the finding in the year 1966 is mentioned in individual localities)**

### Order Caryophyllidea Beneden in Olsson, 1893

### 1. *Caryophyllaeides fennica* (Schneider, 1902) (Fig. 1)

Table 1. Survey of fishes infected with cestodes and localities in which fishes were caught (C — province of Arctic ocean, circumpolar subregion; WM — inner basin of West-Mongolian lakes, West-Mongolian province of upland-Asian subregion; A — Amurian transient region; after Berg 1949)

| Fish species | Number of fishes examined | Localities |
|---|---|---|
| Salmonidae | | |
| *Hucho taimen* (Pallas)* | 5 | lake Dod tsagan (C) |
| *Brachymystax lenok* (Pallas) | 28 | the rivers Tul near Ulan Bator and Songino (C), Kherulen near Kherlen and Onon near Binder (A), lakes Dod tsagan, Khubsugul and Tirkhin tsagan (C) |
| *Coregonus lavaretus pidschian* (Gmelin) | 9 | lake Dod tsagan (C) |
| *Coregonus chadary* Dybowski | 1 | the river Onon near Binder (A) |
| Thymallidae | | |
| *Thymallus arcticus baicalensis* Dybowski** | 31 | lakes Dod tsagan, Khubsugul and Tirkhin tsagan (C) |
| Esocidae | | |
| *Esox lucius* Linné | 14 | lakes Tirkhin tsagan and Ugiy nur, inundant pool of the river Selenga (C) |
| *Esox reicherti* Dybowski | 4 | the rivers Khalkhin gol and Onon near Binder (A) |
| Cyprinidae | | |
| *Leuciscus leuciscus baicalensis* Dybowski | 32 | the river Tul near Ulan Bator and Songino, lakes Tirkhin tsagan and Ugiy nur (C) |
| *Leuciscus waleckii* (Dybowski) | 7 | the river Khalkhin gol (A) |
| *Phoxinus phoxinus* (L.) | 41 | the river Tul near Songino and lake Dod tsagan (C) |
| *Oreoleuciscus potanini* (Kessler) | 15 | lake Khar (Baian) nur (WM) |
| *Oreoleuciscus humilis* Warpachowski | 18 | the river Teisin gol, lakes Sangin dalai nur and Telmen nur (WM) |
| *Oreoleuciscus pewzowi* (Herzenstein) | 12 | lakes Khar (Baian) nur and Sangin dalai nur (WM) |
| *Rutilus rutilus lacustris* (Pallas) | 1 | lake Ugiy nur (C) |
| *Gobio gobio cynocephalus* Dybowski | 4 | the river Onon near Binder (A) |
| *Carassius auratus gibelio* Bloch | 1 | lake Ugiy nur (C) |
| Cobitidae | | |
| *Cobitis taenia sibirica* (Gladkov) | 2 | the river Onon near Binder (A) |
| *Noemacheilus barbatulus toni* Dybowski | 51 | the rivers Selbe near Ulan Bator, Tul near Songino and Ulan Bator (C), Kherulen near Kherlen (A), lakes Khubsugul and Tirkhin tsagan (C) |
| Siluridae | | |
| *Parasilurus asotus* (Linné) | 5 | lake Buir nur (A) |

Table 1 — continued

| Fish species | Number of fishes examined | Localities |
|---|---|---|
| Gadidae | | |
| *Lota lota* (Linné) | 10 | the river Onon near Binder (A), lake Tirkhin tsagan (C) |
| Percidae | | |
| *Perca fluviatilis* Linné | 7 | lakes Tirkhin tsagan and Ugiy nur, inundant pool of the river Selenga (C) |
| Cottidae | | |
| *Cottus szanaga* Dybowski | 7 | the river Onon near Binder (A) |

* According to Hensel and Holčík (1983: Folia zoologica 32: 67—83) *H. taimen* is a subspecies (*H. h. taimen*) of *Hucho hucho* (L.)

** According to Baasanzhav et al. (1983), *Thymallus arcticus arcticus* lives in Selenga river basin in Mongolia and a separate species, *T. nigrescens*, lives in lake Kosogol (Khubsugul).

Hosts: *Oreoleuciscus potanini*, *O. humilis*.
Localization: intestine.
Localities: lake Khar nur (19—20 June), river Teisin gol (8 June).
Material studied: 4 spec. from *O. potanini*.

Remark: Cestodes under study do not differ in morphology and size from *C. fennica* tapeworms described, e. g., by Schneider (1902), Dubinina (1986) and Scholz (1989).

2. *Caryophyllaeides ergensi* Scholz, 1990 (Fig. 1)

Host: *Leuciscus leuciscus baicalensis*.
Localization: intestine.
Localities: river Tul near Songino (13—14 April, 30 July), lake Ugiy nur (25 May).
Material studied: 25 spec.

Remark: The description of the species including its differential diagnosis is given in the paper of Scholz (1990).

3. (?) *Breviscolex orientalis* Kulakovskaja, 1962 (Fig. 2)

Host: *Noemacheilus barbatulus toni*.
Localization: intestine.
Localities: rivers Selbe near Ulan Bator (20—22 and 27—28 April) and Tul near Songino (4 May, 31 July) and near Ulan Bator (6 May), lake Tirkhin tsagan (31 May).
Material studied: 10 spec.

Description: Body length 6.5—10.4, maximum width (1.1—2.0) in anterior half of body. Width of body in region of ovary 0.7—1.2. Head end widely oval-shaped, always narrower than following part of body. Neck lacking, width of body at level of first testes and vitellaria 0.9—1.5. Testes oval, measuring 0.092—0.184 × 0.064—0.129, lying in medullar parenchyma. They beginning immediately behind head end, only 0.30—1.12 from its anterior margin, extending posteriorly to level of cirrus sac, tightly in front of first uterine coils. Cirrus sac oval, 0.28—0.46 × 0.17—0.27 in size, opening into common genital atrium. Ovary H-shaped, with short

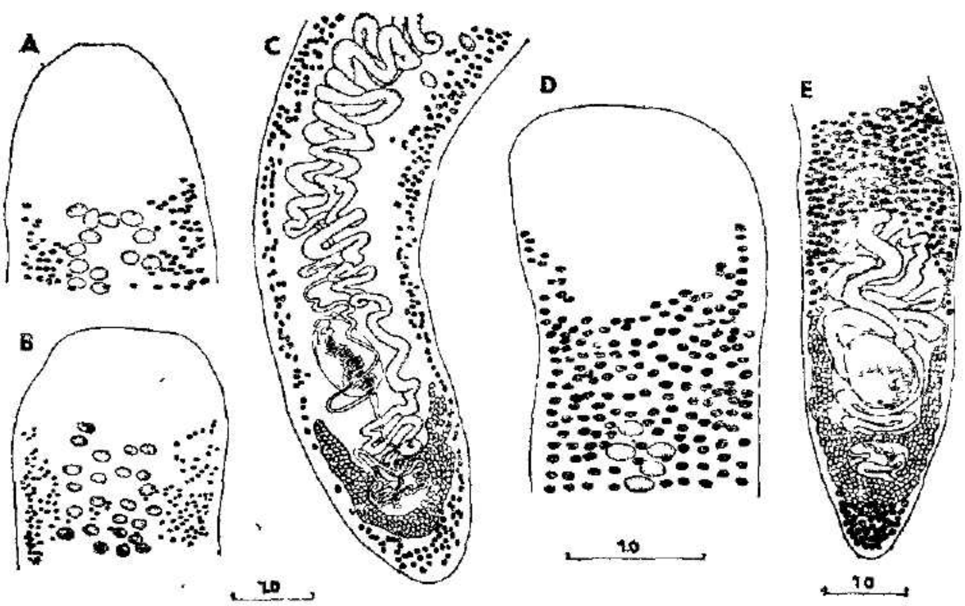


**Fig. 1. A—C — *Caryophyllaeides ergensi* Scholz, 1990 (A, B — head end, C — posterior part of body); D—E — *C. fennica* (Schneider, 1902) (D — head end, E — posterior part of body).**

lobes, situated in posterior part of body. Length of ovary 0.5—0.9, its overall width 0.7—1.1, width of lobes 0.17—0.34, width of connecting bridge 0.07—0.16. Vitelline follicles oval or nearly spherical, measuring 0.05—0.18. First follicles situated immediately behind head end, only 0.52—1.33 from anterior margin of body, i.e. at same distance or more often behind first testes (up to 0.22 behind them). Follicles reaching posteriorly up to cirrus sac and with individual numerous follicles extending along uterine coils and ovarian lobes up to posterior part of body, forming here large postovarian cluster of follicles. Vagina tubular, in proximal part under ovarian connecting bridge slightly expanded into rounded and narrow seminal receptacle measuring 0.10—0.13 × 0.032—0.048. In distal, preovarian part, vagina forming 3—4 small loops and opening into common genital atrium. Uterus tubular, forming about 8—10 tightly rolled coils and opening into atrium. Coils extending anteriorly up to cirrus sac, often at level of its anterior half. Eggs oval, 0.048—0.055 × 0.032—0.033 in size.

Remark: The cestode *B. orientalis* was described by Kulakovskaya in 1962 on the basis of specimens found in *Hemibarbus maculatus* and *Chilogobio czerskii* from lake Bolon and the river Zeya (Amur basin). The second finding from the river Zeya was recorded by Roitman in 1959 (see Kulakovskaya 1962, Dubinina 1971).

Comparison of our data on cestodes from Mongolia with data published by Kulakovskaya (1962) revealed that material from *N. barbatulus toni* differed from *B. orientalis* only in greater body length (according to Kulakovskaya up to 8 mm, in our material up to 14.8 mm) and somewhat smaller size of eggs (0.060—0.064 × 0.041—0.045 mm in *B. orientalis* according to Kulakovskaya, 0.048—0.055 × 0.032—0.033 mm — present data). The hosts of cestodes are also different — cyp-

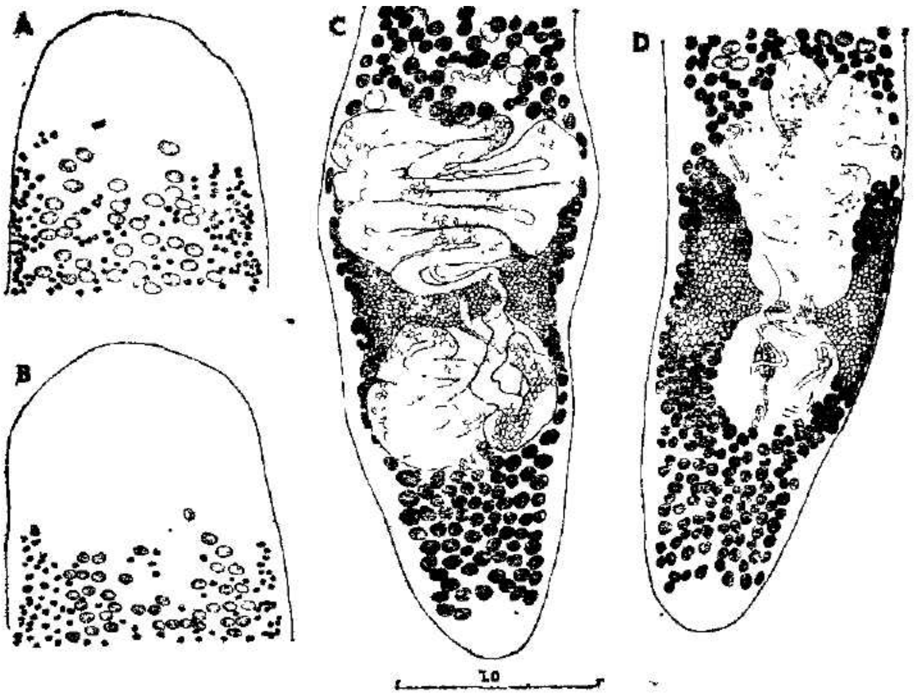


Fig 2. ***Breviscolex orientalis*** **Kulakovskaja, 1962 (?) (A, B — head end, C, D — posterior part of body).**

rinid fishes (Cyprinidae) for *B. orientalis*, cobitid fishes (Cobitidae) for cestodes from Mongolia.

Unfortunately, the way of fixation and processing of our cestodes did not enable to make first-quality transverse sections for ascertaining precise localization of vitelline follicles which is decisive criterion for classification of caryophyllid tapeworms into families (see, e.g., Mackiewicz 1972, Dubinina 1987). Nevertheless, these sections made it possible to exclude appurtenance of our material to the family Lytocestidae Hunter, 1927.

For the reasons mentioned, it is necessary to consider the identification of our material from Mongolia as provisional. The definitive species classification will only be possible on the basis of additional cestode material from the same host and locality. If the appurtenance of our material to the family Capingentidae Hunter, 1930 is proved, cestodes from Mongolia are conspecific with *B. orientalis* In the opposite case, our material from *N. barbatulus toni* would represent a member of the new, up to date unknown cestode species and genus of the family Caryophyllaeidae Leuckart, 1878. That would also explain differences in body length, egg size and fish host type of our tapeworms from Mongolia.

### Order Pseudophyllidea Carus, 1863

4. *Triaenophorus nodulosus* (Pallas, 1781) — adults and larvae

Hosts: ***Esox lucius, E. reicherti*** **(adults);** *Perca fluviatilis, Thymallus* ***arcticus baicalensis, Lota lota, Leuciscus waleckii*** **(larvae — plerocercoids).**

**Localization:** intestine (adults); liver and body cavity (larvae).
**Localities:** lakes Ugiy nur (24 and 25 May) and Tirkhin tsagan (28 and 29 May, 2 June), rivers Khalkhin gol (31 August, 1 and 3 September) and Onon near Bindor (10 September).
**Localities:** lakes Ugiy nur (24 and 25 May) and Tirkhin tsagan (28 and 29 May, 2 June), rivers Khalkhin gol (31 August, 1 and 3 September) and Onon near Binder (10 September)
**Material studied:** living worms (see Remark).

**Remark:** As it was noted in Material and Methods, all tapeworms of the genus *Triaenophorus* were identified immediately after dissection of fishes on the basis of shape of tridental hooks on scolex and were not fixed. However, Kuperman (1968, 1981), who critically revised the genus *Triaenophorus* Rudolphi, 1793, concluded that cestodes from the Amur basin, hitherto designated as *T. nodulosus* and parasitizing *Esox reicherti* (adults) and cyprinid fishes (plerocercoids), represented an independent species *T. amurensis* Kuperman, 1968. On the other hand, Dubinina (1987) considers these cestodes to be only a geographical race (subspecies) of *T. nodulosus*. Consequently, our material from Mongolia probably included not only "typical" *T. nodulosus* but also *T. amurensis* (in Kuperman's concept) or *T. nodulosus amurensis* (after Dubinina 1987).

### 5. *Eubothrium salvelini* (Schrank, 1790) (Fig. 3)

**Host:** *Brachymystax lenok.*
**Localization:** intestine.
**Locality:** river Tul near Ulan Bator (18 April).
**Material studied:** 1 spec.

**Description:** Body length over 35, maximum width 2.5. Scolex widely oval, measuring 0.65×0.73, separated from strobila by neck 0.54 wide. Scolex with well-developed apical disc, wider (0.46) than anterior part of scolex (0.43). Bothria elongated, relatively wide, measuring 0.58×0.40. Apical disc with two wide indentations (Fig. 3C). Segments craspedote, much wider than long, particularly gravid segments. Testes 0.052–0.077×0.041–0.058 in size, forming two laterally situated bands, in proximity of median line of body connected with several testes. Testes not extending up to excretory canals but localized medially from cirrus sac. Cirrus sac elongated or pear-shaped, measuring 0.19–0.26×0.10–0.13, situated laterally in anterior half of segments near median line of body. Ovary elongated, localized near posterior margin of segments, in proximity of median line of body. Vitelline follicles oval, dispersed in great number in cortical parenchyma, filling space between lateral excretory canals. Vagina tubular, without loops, opening laterally anterior to cirrus sac into shallow pit on margin of segments. Uterus forming sac, elongated or irregular in shape, in gravid segments, filling in oldest segments their large part. Eggs oval, 0.041–0.052×0.027–0.034 in size.

**Remark:** The genus *Eubothrium* Nybelin, 1922 consists of 10 species at present (Ching and Andersen 1983). Identification of some species is rather difficult, above all differentiation between two cestodes parasitizing salmonid fishes — *E. salvelini*, a parasite of *Salvelinus*, and *E. crassum* (Bloch, 1779), a parasite of *Salmo*. Size of scolex and shape of its apical disc is considered by some authors (e.g. Nybelin 1922, Rawson 1957, Dubinina 1987) to be a main criterion for differentiation of the two species. However, Kennedy (1978a, b) considers these characters unsuitable for correct species identification. Having evaluated our material, we accept the opinion of Andersen (1979) and Chubb et al. (1987) that the decisive differential character of the two mentioned cestodes is a number of indentations on apical disc of scolex (two wide indentations in *E. salvelini* and four narrow, deep indentations in *E. crassum*). Other criteria presented by Dubinina (1987) — size of scolex, median position of ovary, presence of testes in proximity of median body line — were used as additional ones.

Only *E. crassum* was recorded in *Brachymystax lenok* from the USSR, including the Selenga basin near Mongolia (Zaika 1965, Dubinina 1987). In our opinion, the occurrence of *E. salvelini* in this host also from Soviet territory seems to be very probable.

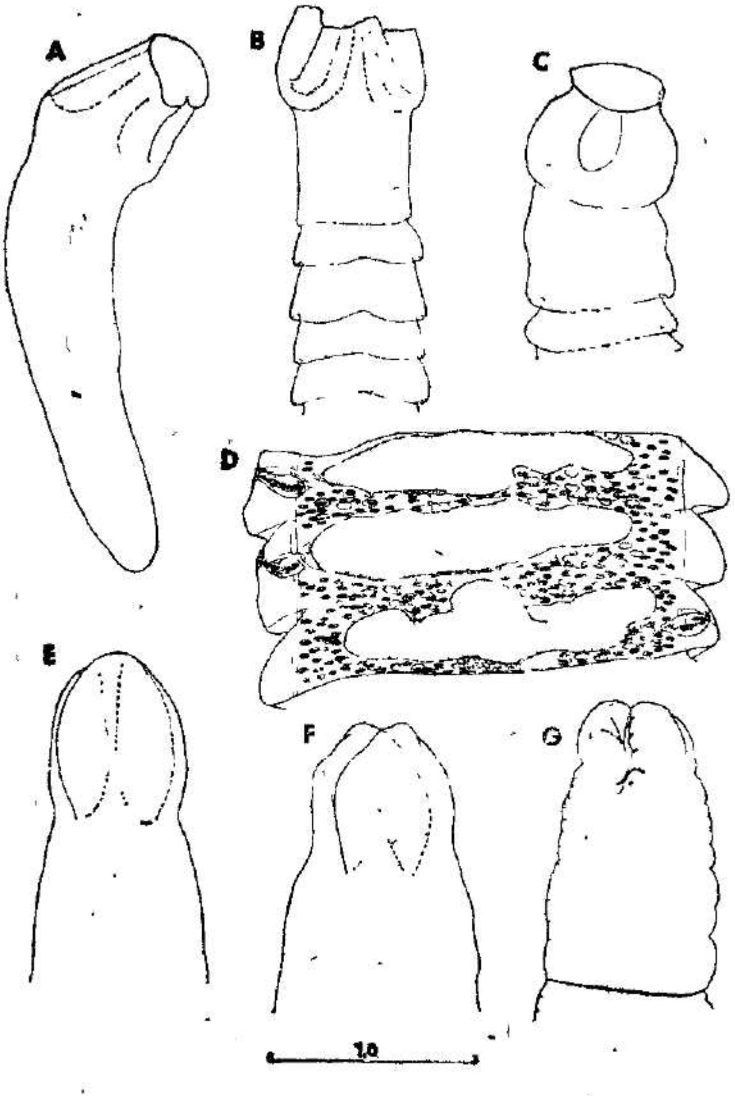


**Fig. 3.** A — *Eubothrium sp.* from *Esox lucius*; B — *Eubothrium* sp. from *Hucho taimen*, anterior part of body; C, D — *E. salvelini* (Schrank, 1790) (C — scolex, D — gravid segments); E—G — *Diphyllobothrium dendriticum* (Nitzsch, 1824), anterior part of plerocercoids.

### 6. *Eubothrium* sp. (Fig. 3)

Hosts: *Hucho taimen*, *Esox lucius*.
Localization: intestine.
Localities: lakes Dod tsagan (7 August) and Tirkhin tsagan (29 May).
Material studied: a fragment (including damaged scolex) of a specimen from *H. taimen*, 1 juvenile specimen from *E. lucius*.

Remark: Material under study excludes correct species identification. Nevertheless, size of scolex, its shape and above all shape of apical disc equipped with only two indentations indicate that our cestodes probable belong of to ***E. salvelini***.

### 7. *Fissurobothrium unicum* Roitman, 1965 (Fig. 4)

Host: *Gobio gobio cynocephalus*.
Localization: intestine.
Locality: the river Onon near Binder (9 September).
Material studied: 1 juvenile specimen.

Description: Body length 2.4, maximum width 0.36. Scolex globular, measuring 0.43×0.43, separated from posterior part of body by neck, 0.29 wide. Apical disc flattened, 0.17 wide. Scolex with two deep bothria, 0.21—0.26×0.20—0.23 in size. Margins of bothria muscular, up to 0.13 wide.

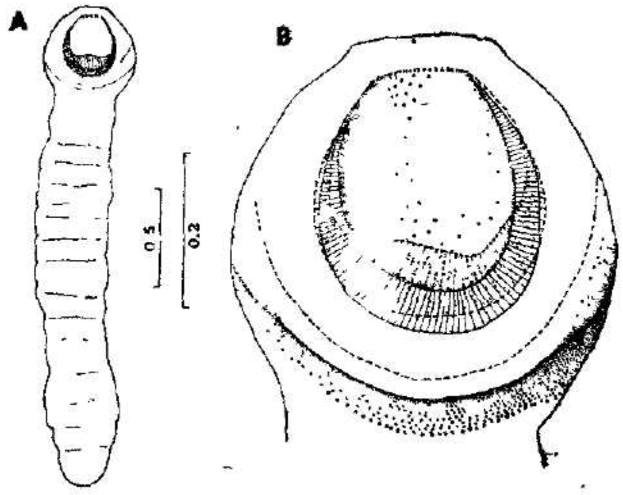


Fig. 4. *Fissurobothrium unicum* Roitman, 1965 (A — total view, B — scolex).

Remark: The only preserved reference specimen (from two found in *G. gobio cynocephalus*) deposited in the collection of the Institute of Zoology of the Academy of Sciences of the USSR in Leningrad was identified by Dubinina as *F. unicum*. This species was originally described by Roitman in 1965 on the basis of cestode material from the same host in the river Zeya (Amur basin, USSR) (Dubinina 1987).

### 8. *Diphyllobothrium dentriticum* (Nitzsch, 1824) — larvae (Fig. 3)

Hosts: *Hucho taimen*, *Brachymystax lenok*, *Thymallus arcticus baicalensis*.

Localization: liver, outer surface of pyloric appendices, stomach and swimmbladder.
Localities: lakes Dod tsagan (7, 9 and 11 August) and Khubsugul (14, 16 and 17 August).
Material studied: anterior parts of four larvae (plerocercoids) from *B. lenok*, the photograph of a histological section through plerocercoid nodule from the gut wall of *T. arcticus baicalensis* (Šlais 1973, Fig. 3, p. 410).

Description: Length of incomplete larvae 6—16, maximum width of body 1.2—1.6. Scolex oval or lanceolate, measuring 0.28—0.83 × 0.46—0.67, mostly (in three spec.) separated from other part of body by distinct neck 0.42—0.66 wide. Bothria long and deep, relatively wide, not narrowing from anterior end backward. Body surface covered with fine microtriches, about 0.008—0.010 long on permanent preparations. Longitudinal muscular fibres situated only in one layer.

Remark. Plerocercoids under study were originally identified by Dubinina as *D. minus*. At present, this species is considered (by Dubinina 1987, too) to be a synonym of *D. dendriticum*, a common parasite of salmonid fishes. Our material corresponds nearly entirely with plerocercoids of *D. dendriticum* described in literature (see, e.g., Chubb et al., 1987, Dubinina 1987, Andersen and Gibson 1989). The only difference — absence of transverse striations (annulations) — in material studied is probably caused by fixation because these deep striations are easily visible on histological section through a nodule of parasite from *T. arcticus baicalensis* (see Šlais 1973).

### 9. *Ligula intestinalis* (Linnaeus, 1758) — larvae (Fig. 8)

Hosts: *Phoxinus phoxinus*, *Rutilus rutilus*, *Cobitis taenia sibirica*.
Localization: body cavity.
Localities: lakes Dod tsagan (6 and 8 August) and Ugiy nur (25 May), river Onon near Binder (7 September).
Material studied: four larvae (plerocercoids) from *R. rutilus* and three plerocercoids from *P. phoxinus*.

Description: Body length 110—165 (specimens from *R. rutilus*) and 53—126 (*P. phoxinus*), maximum width up to 9.5 (6.0), its thickness up to 3 (2.5). Anterior end rounded, not pointed. Genitalia not doubled.

Remark: A reference specimen of *Ligula* plerocercoid found in the body cavity of *C. taenia sibirica* has not been preserved. However, according to Dubinina's conclusions on taxonomy and biology of ligulid tapeworms, it is very probable that our cestode belonged to the species *L. colymbi* Zeder, 1803 the second intermediate hosts of which are exclusively cobitid fishes (Cobitidae) (Dubinina 1980).

## Order Proteocephalidea Mola, 1928

### 10. *Proteocephalus neglectus* La Rue, 1911 (Fig. 5)

Host: *Brachymystax lenok*.
Localization: pyloric appendices and intestine.
Localities: rivers Tul near Ulan Bator and Songino (18 and 19 April), and Kherulen near Kherlen (24 April), lakes Tirkhin tsagan (1 June) and Khubsugul (16 August), river Onon near Binder (7 September).
Material studied: 11 spec.

Description: Body length about 50, maximum width 2.0. Scolex semispherical, measuring 0.3—0.5 × 0.41—0.56, separated from strobila by neck, mostly narrower (width 0.34—0.53) than scolex. Scolex with four circular suckers, 0.122—0.173 in diameter, situated laterally. Terminally situated apical organ ("fifth sucker") measuring 0.057—0.085. Body segmented, segments always wider than long. Size of mature segments 0.5—1.0×1.1—2.0, of gravid ones 0.8—1.0×1.5—1.9. Testes oval or nearly spherical, measuring 0.054—0.168×0.043—0.125, lying in two layers in number 64—100 (mostly 70—80). Cirrus sac bottle-shaped or elongated, 0.336—0.584×0.094—0.131 in size. Cirrus opening in anterior half of segments, on their lateral margin. Cirrus sac extending up to 2/5—1/4 of segments width (mostly about 1/3). Ratio of segments' width to cirrus sac length oscillating from 2.5 to 4.0. Ovary bilobed, situated near posterior margin of segments. Vitelline follicles forming two laterally situated longitudinal bands. Vagina tubular, without loops,

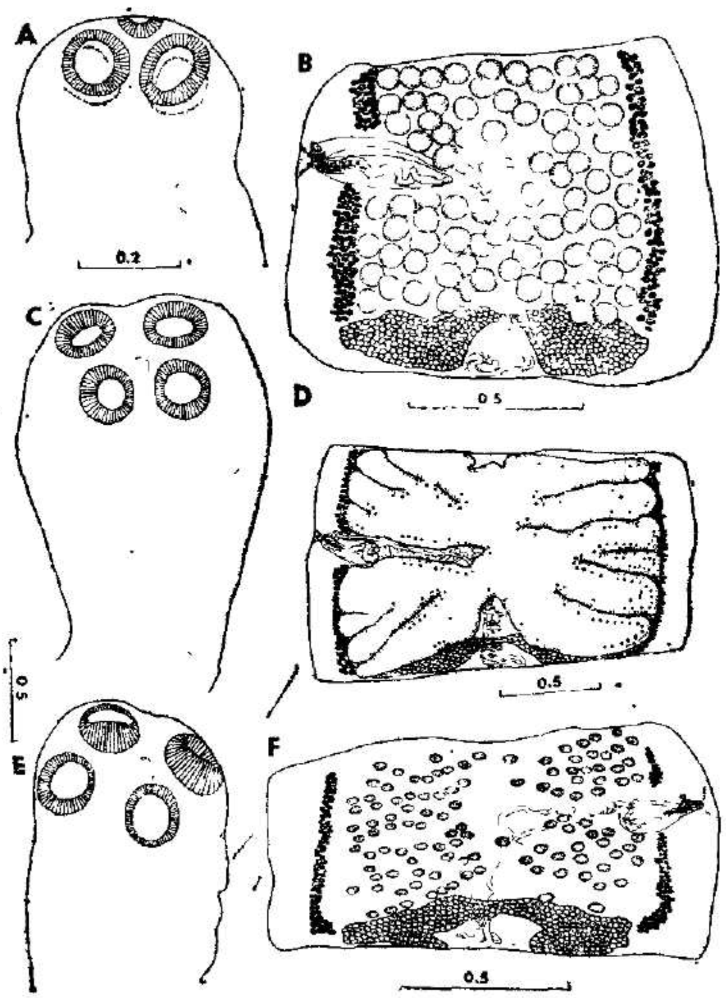


Fig. 5. A, B — *Proteocephalus neglectus* La Rue, 1911 (A — scolex, B — mature segment); C — *P. torulosus* (Batsch, 1786) from *Leuciscus leuciscus baicalensis*, scolex; D—F — *P. torulosus* from *Oreoleuciscus pewzowi* (D — gravid segment, E — scolex, F — mature segment).

opening in front of cirrus into shallow pit on segments margin. Vagina provided in its distal part with oval, feebly developed vaginal sphincter, measuring 0.05—0.06. Uterus lobular, filling large part of segments and forming mostly 6—8 lateral branches. Eggs spherical, measuring 0.032—0.036, containing oncosphere, 0.018—0.023 in diameter.

**Remark:** For identification of this cestode species and other representatives of the genus *Proteocephalus* Weinland, 1858, criteria of **Freze** (1965) and **Dubinina** (1987). were used.

Only *P. exiguus*, a common parasite mainly of coregonid fishes, has hitherto been recorded in salmonid fish *Brachymystax lenok* from the territory of the USSR (**Freze** 1965). This parasite differs from *P. neglectus*, a common parasite of trouts (*Salmo* spp.) and our material, too, after **Freze** (1965) and **Dubinina** (1987) by lower testis number (24—55), position of testes in one layer, greater relative length of cirrus sac (up to 1/2 of segments' width).

Nervetheless, it is necessary to remark that differential criteria mentioned and also characters as body length, number of uterine branches used up to the present time for identification of members of the genus *Proteocephalus* do not make possible reliable differentiation of the cestodes *P. exiguus* and *P. neglectus*. It is caused by great intraspecific variability and morphological polymorphism of the former species (**Anikieva** et al. 1983).

### 11. *Proteocephalus percae* (Müller, 1780) (Fig. 6)

**Host:** *Perca fluviatilis*.
**Localization:** intestine and pyloric appendices.
**Localities:** lakes Ugiy nur (27 May) and Tirkhin tsagan (5 June), inundant pool of the river Selenga (3 August).
**Material studied:** 5 spec.

**Description:** Body length 55—60, maximum width 2.7. Anterior end of body considerably narrow forward. Scolex measuring 0.3—0.4×0.20—0.32, separated from strobila by feebly recognizable neck, slightly narrower than scolex (width 0.20—0.30). Scolex with four relatively large (diameter 0.065—0.116) laterally situated suckers. Ratio of sucker diameter to scolex width 0.30—0.37. Apical organ ("fifth sucker") 0.027—0.049 in diameter. Ratio of sucker diameter to diameter of apical organ 2.0—2.6. Body segmented, segments always wider than long, size of mature segments 0.2—0.4×1.1—2.0, of gravid ones 0.5—0.9×1.2—2.7. Testes oval, measuring 0.04—0.13×0.03—0.08, lying irregularly in one layer in number 70—96. Cirrus sac long, oval or elongated, rarely in some segments pear-shaped with wider proximal part, measuring 0.22—0.55×0.064—0.106. Cirrus sac representing only 1/7—2/7 of segments' width (ratio of that width to cirrus sac length 3.6—6.9, usually 4.5—6.0). Cirrus opening laterally in anterior half of segments. Ovary bilobed, situated near posterior margin of segments. Vitelline follicles forming two laterally situated bands. Vagina tubular, without loops, opening laterally anterior to cirrus opening. Vagina in its distal part with feebly developed oval sphincter, 0.05—0.07 in diameter. Uterus lobular, forming mostly 6—8 lateral branches. Eggs spherical, measuring 0.026—0.038, containing oncosphere 0.014—0.025 in diameter.

**Remark:** Cestodes under study somewhat differ from *P. percae* described, e.g., by **La Rue** (1914), **Freze** (1965), **Scholz** (1989) only in the shape and smaller relative length of cirrus sac in relation to segments width. Pear-shaped cirrus sacs in some segment and small ratio of their length to segments width (about 1/4—1/5) somewhat resemble the same characteristics in *P. cernuae* (Gmelin, 1790), a parasite of percid fishes, particularly ruffs (*Gymnocephalus* spp.) (La Rue 1914, Freze 1965, Dubinina 1987, Scholz 1989).

However, the species *P. cernuae* distinctly differs from *P. percae* and also from our material from Mongolia by the shape and size of scolex and by terminal (apical) position of suckers, which are somewhat larger in diameter. Consequently, the ratio of sucker diameter to scolex width is smaller in *P. cernuae* than in *P. percae* — see Scholz (1989). There is a slight difference between the two species in overall length of cirrus sac, too (see Freze 1965).

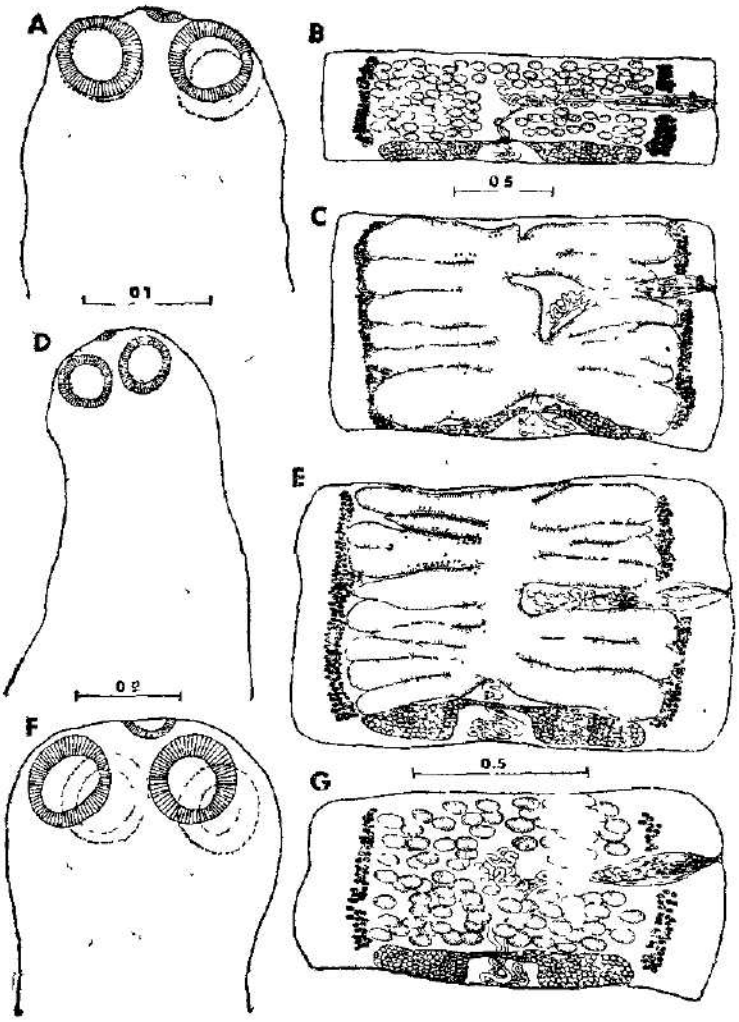


Fig. 6. A—C — ***Proteocephalus percae*** (Müller, 1780) (A, D — scolex, B — **mature segment**, C — gravid segment); E—G — *P. thymalli* (Annenkova-Chlopina, 1923) (E — **gravid segment**, F — scolex, G — mature segment).

### 12. *Proteocephalus thymalli* (Annenkova-Chlopina, 1923) (Fig. 6)

Host: *Thymallus arcticus baicalensis.*
Localization: intestine and pyloric appendices.
Localities: lakes Dod tsagan (9 and 11 August) and Khubsugul (14–16 August).
Material studied: 14 spec.

Description: Body length about 40–50, maximum width 1.7. Scolex semispherical, measuring 0.4–0.8 × 0.41–0.70, separated from strobila by neck, 0.34–0.56 wide. Scolex with four laterally situated, relatively large suckers, 0.147–0.208 in diameter, and apical organ ("fifth sucker") with well-developed musculature, measuring 0.071–0.097 in diameter. Body segmented, segments always wider than long. Measurements of mature segments 0.3–0.6 × 1.1–1.5, of gravid ones 0.5–1.0 × 0.8–1.7. Testes oval, lying in two layers in number 59–94, measuring 0.05–0.16 × 0.03–0.10. Cirrus sac tear-shaped or oval, measuring 0.192–0.432 × 0.045–0.102, extending up to 1/5–2/5 (mostly 1/3–1/4) of segments width (ratio of segments width to cirrus sac length 2.5–5.4). Cirrus opening laterally in anterior half of segments. Ovary bilobed, situated near posterior margin of segments. Vitelline follicles forming two longitudinal bands in margin of segments. Vagina tubular, opening laterally anterior to cirrus opening into shallow pit. Vagina in its distal part with oval, feebly developed vaginal sphincter, 0.04–0.05 in diameter. Uterus lobular, forming 6–10 (mostly 8–9) lateral branches. Eggs spherical, measuring 0.028–0.035, with oncosphere 0.015–0.019 in diameter.

Remark: According to Freze (1965) and Dubinina (1987), the cestode *P. thymalli* is a common parasite of graylings (*Thymallus* spp.) in the USSR. It was also found in Mongolian lake Kosogol (Khubsugul) – Pronin et al. (1979). Our material from Mongolia does not differ from *P. thymalli* described by Annenkova-Chlopina (1923), Freze (1965) and Rusinek (1987). However, we did not succeed, similarly as Rusinek (1987), in recording a characteristic feature of *P. thymalli* – cirrus sac dorsally rounded in its half (Dubinina 1987).

Material we studied resembles in some features (shape of scolex, relative length of cirrus sac, testis number, number of uterine lateral branches, etc.) cestodes from *Brachymystax lenok*, identified by us as *P. neglectus* (see page 12). Mutual differentiation of the two mentioned species (*P. neglectus* and *P. thymalli*) only on the basis of criteria recommended by Dubinina (1987) seems not to be, in our opinion, completely sufficient. Moreover, it cannot be excluded that slight differences we found while comparing the cestode from *B. lenok* and *T. arcticus baicalensis* (larger suckers and strongly muscular apical organ, slightly shorter cirrus sac of cestodes from *Thymallus*) represent only intraspecific variability of the only species similarly as Anikieva et al. (1983) found in morphologically different populations of polymorphic species *P. exiguus* from coregonid fishes. On the other hand, results of Willemse's (1969) and Pronina and Pronin's (1988) experiments indicating very narrow specificity of *Proteocephalus* cestodes at the level of definitive host support independence of the two above mentioned tapeworms.

### 13. *Proteocephalus torulosus* (Batsch, 1786) (Fig. 5)

Hosts: *Leuciscus leuciscus baicalensis, Oreoleuciscus pewzowi, O. potanini.*
Localization: intestine.
Localities: the river Tul near Ulan Bator (15 April, 30 July), lakes Ugiy nur, Tirkhin tsagan (23 May, 3 June) and Khar (Baian) nur (19–22 June).
Material studied: 6 spec. from *L. leuciscus baicalensis*, 1 spec. from *O. pewzowi.*

**Description**: Body length about 40—50, maximum width 2.1. Scolex club-shaped, measuring 1.2—2.0×1.10, with four circular suckers, 0.15—0.34 in diameter, situated terminally (apically). Glandular apical organ well-developed, 0.058—0.094 in diameter. Neck 0.43—0.95 wide. Body segmented, segments nearly always wider than long. Size of mature segments 0.2—0.9×1.1—1.6, of gravid ones 0.3—1.9×1.7—2.1. Exceptionally, gravid segments square-shaped or slightly longer than wide (measurements 1.83—1.91×1.79—1.89). Testes oval, measuring 0.05—0.14×0.03—0.12, lying in two layers in number 110—145. Cirrus sac oval or pear-shaped with wider proximal part, measuring 0.26—0.43×0.064—0.170. Its length representing only 1/7—1/4 (mostly 1/5—1/6) of segments' width. Ovary bilobed, situated near posterior margin of segments. Vitelline follicles forming two longitudinal, laterally situated bands. Vagina tubular, opening on margin of segments, anterior to cirrus. Vagina in its distal part with oval, very feebly developed vaginal sphincter, 0.05—0.07. Uterus lobular, forming mostly only 5—6 lateral branches. Eggs spherical, 0.028—0.045 in diameter, containing oncosphere measuring 0.013—0.021.

Table 2. Measurements of juvenile cestodes of the genus *Proteocephalus* (in millimetres)

| | *Coregonus chadary* | *Noemacheilus barbatulus toni* | *Lota lota* | *Cottus szanaga* |
|---|---|---|---|---|
| Body length | 2.2 | 2.5—10.2 | 1.4 | 1.2—2.2 |
| Body width | 0.44 | 0.42—0.64 | 0.70 | 0.39—0.51 |
| Scolex length | 0.24 | 0.34—0.64 | — | 0.30—0.32 |
| Scolex width | 0.38 | 0.50—0.86 | 0.37 | 0.42—0.51 |
| Neck width | 0.38 | 0.31—0.62 | — | 0.38—0.50 |
| Sucker diameter | 0.12—0.13 | 0.13—0.22 | 0.10—0.14 | 0.07—0.13 |
| Diameter of apical organ | 0.065 | 0.045—0.076 | 0.062 | 0.052—0.081 |

**Remark**: Cestodes under study do not differ from *P. torulosus* described in literature (see, for example, Freze 1965, Dubinina 1987) or from our comparative material from Czechoslovakia (Scholz 1989). This common and widely distributed parasite of cyprinid fishes was also recorded in fishes of the genus *Oreoleuciscus* from West-Mongolian lakes — Anikieva et al. (1987). There are only slight differences between our material and cestodes found in Mongolia by these authors — somewhat smaller relative length of cirrus sac length and the presence of vaginal sphincter in our material. Nevertheless, vaginal sphincter in *P. torulosus* is hardly visible in permanent preparations and it can be overlooked.

### 14. *Proteocephalus* spp. juv. (Fig. 7)

**Hosts**: ***Hucho taimen, Coregonus lavaretus pidschian, C. chadary, Esox lucius, Phoxinus phoxinus, Noemacheilus barbatulus toni, Lota lota, Cottus szanaga.***

**Localization**: intestine and pyloric appendices.

**Localities**: the rivers Tul near Songino (5 April), Kherlen near Kherulen (26 April), Selbe (27 April) and Tul (6 and 9 May) near Ulan Bator, lake Khubsugul (17 April), inundant pool of the river Selenga (3 August), lake Dod tsagan (6—9 August), the river Onon near Binder (7, 9, 10 September).

**Material studied**: 5 spec. from ***N. barbatulus toni***, 1 spec. from ***C. chadary***, 1 spec. from ***L. lota***, 2 spec. from ***C. szanaga.***

**Remark:** Correct species identification of cestodes under study or mutual differentiation of parasites from different host is not possible. Consequently, we only add a survey of measurements of cestodes examined in Table 2.

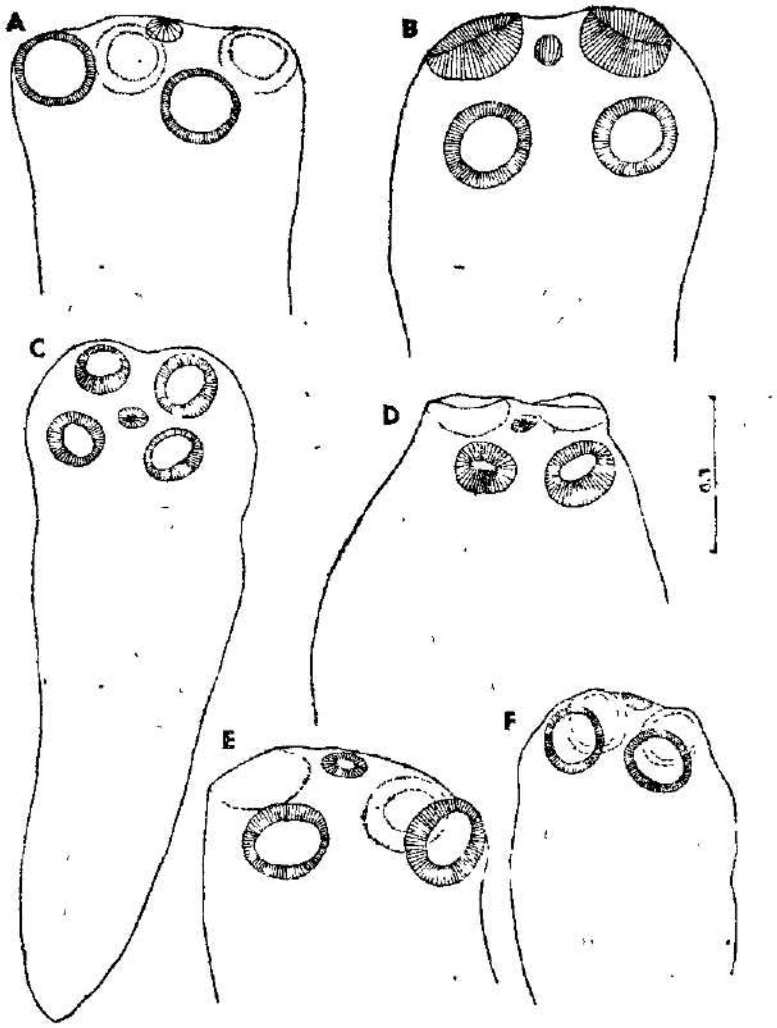


Fig. 7. A, B — *Proteocephalus* sp. juv. from *N. barbatulus toni* (scolex); C, E — *Proteocephalus* sp. juv. from *C. ezanaga* (C — total view, E-scolex); D — *Proteocephalus* sp. juv. from *L. lota* (scolex); F — *Proteocephalus* sp. juv. from *C. chadary* (scolex).

### 15. *Gangesia* sp. (Fig. 8)

**Host:** *Parasilurus asotus.*
**Localization:** intestine.
**Locality:** lake Buir nur (11 September).
**Material studied:** 1 scolex.

**Description:** Scolex oval, measuring 0.58 × 0.71, with four circular suckers, 0.17—0.21 in diameter. Circular rostellum, measuring 0.25 in diameter, armed with 47 minute hooks. Hooks consist of basal plate 0.009—0.010 long and 0.003—0.004 wide and slightly rounded and pointed tip, 0.010—0.014 long.

**Remark:** Two cestode species of the genus *Gangesia* Woodland, 1924, *G. parasiluri* Yamaguti, 1934 and *G. polionchis* Roitman et Freze, 1964, have hitherto been described from *Parasilurus asotus*. Roitman and Freze (1964) and Freze (1965) differentiate both species by number of rostellar hooks (*G. parasiluri* 32—37, *G. polionchis* 40—52) and by number of uterine branches (*G. parasiluri* over 20, *G. polionchis* up to 20). According to hook number and shape, our scolex corresponds entirely with *G. polionchis* (see Roitman and Freze 1964). However, Dubinina (1971) found the cestode *G. parasiluri* from *P. asotus* in the river Amur having 33—48 hooks on rostellum. This fact excludes the use of hook number as differential criterion for identification of *G. parasiluri* and *G. polionchis*. The author (Dubinina 1987) used for differentiation of the cestodes only positions of bands of vitelline folicles to longitudinal excretory canals. Moreover, Dubinina (1987) pointed out the necessity to confirm the independence and validity of the two above referred taxons. For this reason and because we studies only scolex of one cestode, we have designated this specimen from *Parasilurus asotus* provisionally as *Gangesia* sp.

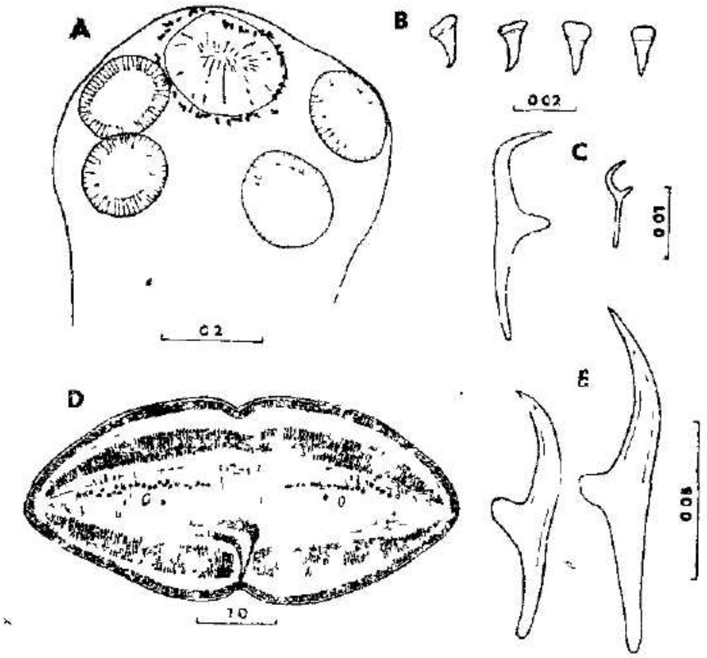


Fig. 8 A, B — *Gangesia* sp. (A — scolex, B — rostellar spines); C — *Valipora campylancristrota* (Wedl, 1855) larvae; D — *Ligula intestinalis* (Linnaeus, 1758) plerocercoid, transverse section; E — *Paradilepis scolecina* (Rudolphi, 1819) larvae, rostellar hooks.

## Order Cyclophyllidea Beneden in Braun, 1900

### 16. *Paradilepis scolecina* (Rudolphi, 1819) — larvae (Fig. 8)

**Hosts:** *Oreoleuciscus pewzowi*, *O. humilis*.
**Localization:** liver, mesentery.
**Localities:** lakes Sangin dalai nur (11—13 June), and Telmen nur (16 June).
**Material studied:** 3 spec. from *O. pewzowi*, 3 spec. from *O. humilis*.

**Remark:** Cestodes under study are morphologically and biometrically (length of larger rostellar hooks 0.101—0.107, length of smaller ones 0.074—0.080) identical with larvae of *P. scolecina* described for instance by **Kozicka** (1971), **Dubinina** (1987), and with our comparative material from Czechoslovakia (**Scholz** 1989).

### 17. *Valipora campylancristrota* (Wedl, 1855) — larvae (Fig. 8)

**Host:** *Carassius auratus gibelio*.
**Localization:** gall bladder.
**Locality:** lake Ugiy nur (24 May).
**Material studied:** 1 spec.

**Remark:** Material from Mongolia corresponds in shape and size (length of larger rostellar hooks 0.028—0.029, length of smaller ones 0.013) entirely with larvae of *V. campylancristrota* described in literature (e.g., **Kozicka** 1971, **Bona** 1975, **Scholz** 1989).

### REFERENCES

**Andersen K.**, 1979: Studies on the scolex morphology of Eubothrium spp. with emphasis on characters usable in species discrimination and with brief references on the scolices of Bothriocephalus sp. and Triaenophorus spp. (Cestoda: Pseudophyllidea). *Z. Parasitenkd.* 60 · 147—156.

**Andersen K., Gibson D. I.**, 1989: A key to three species of larval Diphyllobothrium Cobbold, 1858 (Cestoda: Pseudophyllidea) occurring in European and North American freshwater fishes. *Syst. Parasitol.* 13 : 3—9.

**Anikieva L. V., Malakhova R. P., Yeshko E. P.**, 1983: Ecological analyses of parasites of coregonid fish. Izd Nauka, Leningrad, 168 pp. (In Russian.)

**Anikieva L. V., Pugachev O. N., Paranlayzhamts Z.**, 1987· Cestodes of the genus Proteocephalus from West-Mongolian minnows (Oreoleuciscus: Cyprinidae) *Tr Zool. Inst. AN SSSR, Leningrad*, 161 : 94—106 (In Russian.)

**Annenkova-Chlopina N. P.**, 1923: Helminthological remarks I—III. *Ezhegodnik Zool. mus.* 24 . 32—43. (In Russian.)

**Baasanzhav G., Dgebuadze Yu. Yu., Demin A. N., Dulmaa A., Yermokhin V. Ya., Lapsin V. I., Ryabov I. N., Tugarina P. Ya.**, 1983: A survey of ichthyofauna of Mongolia. In Fishes of the Mongolian People's Republic (Sokolov V. E. ed.), Izd. Nauka, Moscow, pp. 102—224. (In Russian.)

**Berg L. S.**, 1949: Freshwater fishes of the USSR and related countries. Vol. 2. Izd. AN SSSR, Moscow-Leningrad, 925 pp. (In Russian.)

**Bona F. O.**, 1975: Etude critique et taxonomique des Dilepididae Fuhrmann, 1907 (Cestoda) parasites des Ciconiiformes. Consiglio Nationale delle Ricerche, Roma, 750 pp.

**Ching L. H., Andersen K.**, 1983: Description of Eubothrium tulipai sp. n. (Pseudophyllidea: Amphicotylidae) from northern squawfish in British Columbia. *Can J. Zool* 61 : 981—986.

**Chubb J. C., Pool D. W., Veltkamp C. J.**, 1987: A key to the species of cestodes (tapeworms) parasitic in British and Irish freshwater fishes. *J. Fish. Biol* 31 : 517—543.

**Dubinina M. N.**, 1971: Fish tapeworms from Amur basin. *Parazitologicheskiy sbornik 25, Leningrad*: 77—119. (In Russian.)

**Dubinina M. N.**, 1980: Tapeworms (Cestoda, Ligulidae) of the fauna of the USSR. Transl. from Russian, Amerind Publ Co., New Delhi, 320 pp.

**Dubinina M. N.**, 1987: Class tapeworms — Cestoda Rudolphi, 1808. In Bauer O. N. (Ed.): Key to the parasites of freshwater fishes. Vol. 3. Izd. Nauka, Leningrad, pp. 5—76. (In Russian.)

**Ergens R., Dulmaa A.**, 1967: Monogenoidea from the genus Phoxinus (Cyprinidae) from Mongolia. *Folia parasitol.* 14 : 321–333.

**Ergens R., Dulmaa A.**, 1968: Monogenoidea in Cobitis taenia sibirica from Mongolia. *Folia parasitol* 15 : 317–321.

**Freze V. I.**, 1965: Proteocephalids — tapeworm helminths of fishes, amphibians and reptiles. Essentials of Cestodology, Vol. 5. Izd. Nauka, Moscow, 539 pp. (In Russian.)

**Kennedy C. R.**, 1978 a: The biology, specificity and habitat of the species of Eubothrium (Cestoda: Pseudophyllidea), with reference to their use as biological tags: a review. *J. Fish Biol* 12 : 393–410.

**Kennedy C. R.**, 1978 b: Studies on the biology of Eubothrium salvelini and E. crassum in resident and migratory Salvelinus alpinus and Salmo trutta and S. salar in North Norway and the islands of Spitsbergen and Jan Mayen. *J. Fish Biol.* 12 : 147–162.

**Kozicka J.**, 1971: Cestode larvae of the family Dilepididae Fuhrmann, 1907 parasitizing freshwater fish in Poland. *Acta Parasitol. Pol.* 19 : 85–93.

**Kulakovskaya O. P.**, 1962: New species of caryophyllids Breviscolex orientalis (Caryophyllaeidae, Cestodes) from fish of Amur basin. *Dokl. AN SSSR, Moscow,* 143 : 1001–1004. (In Russian.)

**Kuperman B. I.**, 1968: New species of the genus Triaenophorus Rud. (Cestoda, Pseudophyllidea). *Parazitologiya* 2 : 495–502. (In Russian.)

**Kuperman B. I.**, 1981: Tapeworms of the genus Triaenophorus parasites of fishes. Transl. from Russian. Amerind Publ. Co., New Delhi, 222 pp.

**La Rue G. R.**, 1914: A revision of the cestode family Proteocephalidae. Illinois Biol. Monographs 1 : 1–351.

**Markiewicz J. S.**, 1972: Caryophyllidea (Cestoidea): a review. *Exp. parasitol.* 31 : 417–512.

**Moravec F., Ergens R.**, 1970: Nematodes from fishes and cyclostomes of Mongolia. *Folia parasitol.* 17 : 217–232.

**Nybelin O.**, 1922: Anatomisch-systematische Studien über Pseudophyllideen. *Göteborgs Kungl. Vet. Vit. Samh. Handl.* 26 (41) : 1–228.

**Pronin N. M.**, 1974: On the parasite-fauna of Mongolian grayling. *Mater. nauch. Vsesoyuz. konf. gelm.* 26 : 208–211. (In Russian.)

**Pronin N. M., Ryzhova L. N., Tugarina P. Ya., Tyutrina L. I.**, 1979: Morphophysiological study of grayling from Khubsugul lake, Mongolia. Zooparazitologiya basseina ozera Baikal, Ulan-Ude: 106–121. (In Russian.)

**Pronina S. V., Pronin N. M.**, 1988: Interrelations in the systems helminths — fishes. Nauka, Moscow. 177 pp. (In Russian.)

**Rawson D.**, 1957: The anatomy of Eubothrium crassum (Bloch) from the pyloric caeca and small intestine of Salmo trutta L. *J. Helminthol.* 31 : 103–120.

**Roitman V. A., Freze V. I.**, 1964: New species of the genus Gangesia (Cestoda, Proteocephalata) from fish of Amur basin. Trudy GELAN, Moscow, 14: 170–181. (In Russian.)

**Rusinek O. T.**, 1987: On the cestodes of the genus Proteocephalus parasites of fish of Baikal lake. *Parazitologiya* 21 : 127–133. (In Russian.)

**Schneider G.**, 1902: Caryophyllaeus fennicus n. sp. *Arch. Naturgesch.* 1 : 65–71.

**Scholz T.**, 1989: Amphilinida and Cestoda, parasites of fish in Czechoslovakia. *Acta Sci. Nat. Brno 23* (4), 56 pp.

**Scholz T.**, 1990: Caryophyllaeides ergensi sp. n. (Cestoda: Caryophyllidea) from Leuciscus leuciscus baicalensis in Mongolia. *Folia parasitol.* 37 231–235.

**Šlais J.**, 1973: Functional morphology of cestode larvae. *Adv. Parasitol.* 11 : 395–480.

**Willemse J. J.**, 1969: The genus Proteocephalus in Netherlands. *J. Helminthol.* 43 : 207–222.

**Zaika V. E.**, 1965: Parasite-fauna of fish from Baikal lake. Izd. Nauka, Moscow, 108 pp. (In Russian.)

Received April 24, 1989; accepted March 8, 1990

*Acta Soc. Zool. Bohemoslov.*, **54**: 305—319, 1990
ISSN 0862—5247

# SALMONIDS IN THE OHRID-DRIM-SKADAR SYSTEM

Vitko ŠORIĆ

Institute of Biology, Faculty of Science, R. Domanovića 12,
34000 — Kragujevac, Yugoslavia

Abstract. In the Ohrid-Drim-Skadar system, the presence and the diffusion of the six autochthonous species belonging to the genera of *Salmo* and *Salmothymus* were confirmed. The diagnoses and the descriptions were given according to their anatomical-morphological characteristics established by former investigations and this one as well.

## INTRODUCTION

The significant investigations related to the problems of Salmonidae in Ohrid-Drim-Skadar system were begun at the end of the XIXth century by the foreign researches, among which the results of Steindachner (1892), Berg (1910, 1932), Doflein (1918) and Drenski (1922) should be pointed out. Although their investigations were periodical, they gave remarkable contribution to the investigation of this complex and specific problem. The organized and long lasting, but insufficient investigations were done by our researchers: Karaman (1924 to 1957), Stanković (1937. 1960), Stefanović (1948), Drecun (1962). Hadžišće (1962), Sidorovski (1955), M. Karaman (1966), Ivanović (1973) te al. From the data given by the mentioned authors in this system: *Salmothymus ohridanus* (Steindachner, 1892) (formerly *Salmo ohridanus*) in the Ohrid Lake; *Salmothymus obtusirostris zetenzis* (Hadžišće, 1962) (= *Salmo zetenzis*) in the Zeta (a tributary of the Skadar Lake); *Salmo letnica letnica* Karaman, 1924 (= *Trutta letnica*) in the Ohrid Lake; *Salmo letnica balcanica* Karaman, 1926 (= *Trutta balcanica*) in Ohrid Lake; *Salmo letnica aestivalis* Stefanović. 1948 in Ohrid Lake; *Salmo letnica lumi* Poljakov, 1958 in Ohrid Lake; *Salmo taleri* Karaman, 1932 in Zeta; *Salmo montenegrinus* Karaman in Radika river, Ohrid Lake, Drim and Morača rivers; *Salmo farioides* Karaman, 1937 in Radika, Mavrovo Lake, and Pećka Bistrica (a tributari of Beli Drim); *Salmo marmoratus* Cuvier, 1817 in Skadar Lake, Radika and Beli Drim and *Salmo dentex* Heckel, 1851 in Skadar Lake system, were described or only stated.

M. Karaman (1966) however, concludes that in the Ohrid-Drim-Skadar system there are two species of genus *Salmothymus*: *S. ohridanus* (Steindachner, 1892) in Ohrid Lake and *S. obtusirostris zetenzis* (Hadžišće, 1962) in Zeta and the genus *Salmo* with the species *Salmo letnica* which is differentiated into three subspecies: ssp. *letnica* Karaman, 1924 in Ohrid Lake; ssp. *farioides* Karaman, 1937 in the Drim system and ssp. *taleri* Karaman, 1937 in the system of Skader Lake. Ivanovič (1973) states the presence of 4 autochthonous species of trouts in the system of Skadar Lake: *Salmo trutta* m. *fario* Linnaeus, *Salmo dentex* Heckel, 1851, *Salmo marmoratus* Cuvier, 1817 and *Salmothymus obtusirostris zetenzis* (Hadžišće, 1962).

The earlier different descriptions of only one trout, and some later data about the presence and the systematical status of some trouts in the Ohrid-Drim-Skadar system, induced me, on the basis of my own research and accessible data by other researchers, to present my contribution to the clearing and explanation of these problems.

## MATERIAL AND METHODS

The material for this research has been periodically caught since 1974 from the Ohrid Lake; while from Pećka Bistrica and Miruša (Beli Drim river basin) it was caught from 1974 to 1989. At the begining of this year the samples from the Resava river (Velika Morava river basin) were caught.

I obtained the specimens from the Skadar Lake from r. Marić in 1988.

The samples were analyzed by usual methods, which had also been used by other authors in similar investigations.

## RESULTS AND DISCUSSION

The analysis of the samples from Beli Drim system, Ohrid and Skadar Lakes, and the Resava river (Velika Morava system), with the use of formerly established data for trouts from our other waters, shows that in Ohrid-Drim-Skadar system: *Salmo letnica* Karaman, 1924; *Salmo trutta farioides* Karaman, 1937; *Salmo marmoratus* Cuvier, 1817; *Salmo dentex* Heckel, 1851; *Salmothymus ohridanus* (Steindachner, 1892) and *Salmothymus obtusirostris zetenzis* (Hadžišće, 1962) are present. The presence and the systematical status of the other described taxonomical units have not been fully established up till now. M Karaman (1966) considers *Salmo montenegrinus* Karaman, 1933 as a representative of one local race of the subspecies of *Salmo letnica farioides*, and the described forms of *Salmo letnica: balcanicus, aestivalis* and *lumi* only a part of one population or local micropopulation, for which there is no indication in the existing taxonomy.

### *Salmo trutta farioides* Karaman, 1937 (Fig. 3)*

Was previously described from the waters of the Krka near Knin as *Salmo farioides*, whose areal comprises the whole Adriatic river basin. The presence of *Salmo trutta* m. *fario* in our waters was contested at that time, because it was considered that *Salmo farioides* populated the Adriatic river basin, *Salmo taleri* the Black Sea river basin and *Salmo macedonicus* the Aegean river basin (Karaman, 1937, 1957). At the same time there were other data which, as was pointed out in later investigations, showed that *Salmo trutta* m. *fario* was present in the Danubian system and in other neighbouring waters (Drenski, 1926; Taler, 1950; Drecun, 1962; Mihajlova, 1965; Oliva et al, 1968; Arbocco, 1966; Tortonese, 1971; Banarescu, 1964, 1980/81; Hriženjak et Ehrlich, 1981; Jankov et Živkov, 1988).

Analysing the characteristics of stream trout from the Resava (a tributary of Velika Morava, Danubian river basin) we confirmed the data of Grubič et al. (1982) than in this river *Salmo trutta* m. *fario* was present. The comparison of individuals, of approximately same dimensions, from the Resava river and the Pećka Bistrica (a tributary of B. Drim) pointed out to the outstanding uniformity of these trouts in the majority of meristic characters. However, in

Table 1. Plastic and meristic characters of the *Salmo trutta fario* L. from Resava R. (Morava system), total length 109—140 mm

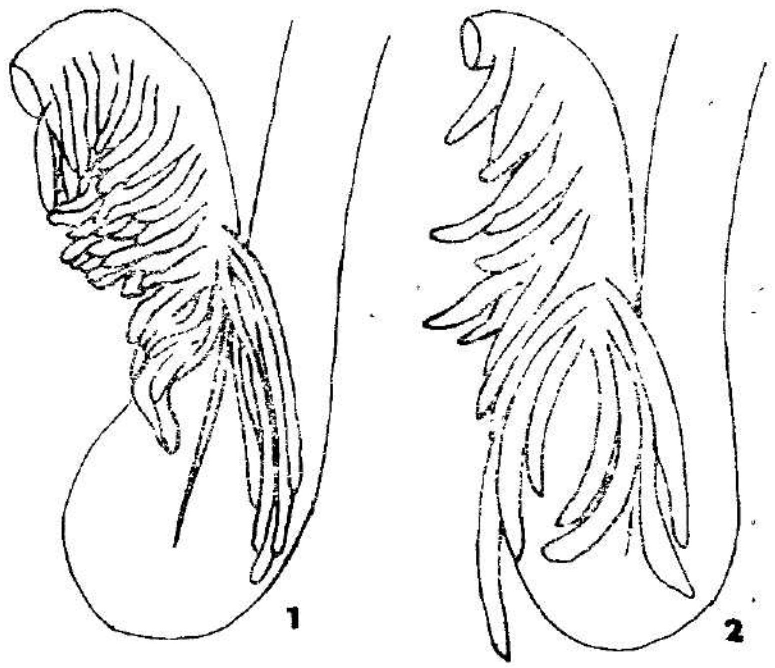
| In % long. corp. | Ranges | M | SD |
|---|---|---|---|
| long. capitis | 25.62—28.40 | 26.66 | 1.00 |
| dist. praedors. | 46.10—47 21 | 46.73 | 0 49 |
| dist. postors. | 40.03—45 33 | 42.62 | 1 64 |
| dist. praean. | 72.15—78.60 | 74.81 | 2.35 |
| dist. praeven. | 54.08—57.70 | 55.71 | 1.55 |
| alt. corp. max. | 24.09—26.65 | 25.53 | 1.03 |
| alt. corp. min. | 10.14—10.61 | 10.34 | 0.18 |
| long. ped. caud. | 17.57—18.49 | 18.05 | 0.33 |
| long. D | 12.71—14.58 | 13.19 | 1.04 |
| alt. D | 18.06—21.44 | 19.64 | 1.16 |
| long. A | 8.60—11.34 | 9.87 | 1.02 |
| alt. A | 15.05—17.68 | 16.76 | 0.90 |
| alt. P | 18.83—22.87 | 20.58 | 1.32 |
| alt. V | 13.16—15.47 | 14.22 | 0.78 |
| long. C | 19.35—23.87 | 21.80 | 1.66 |
| In % long. cap. | | | |
| alt. capitis | 56.42—63.76 | 61.31 | 2.54 |
| dist. praeoc. | 21.48—28.86 | 27.24 | 1.63 |
| dist. postoc. | 51.75—56.30 | 53.51 | 1.22 |
| diamet. oculi | 22.19—25.29 | 23.65 | 1.03 |
| dist. interoc. | 27.93—30.74 | 28.93 | 0.96 |
| linea lat. | 117—122 | 117.60 | 2.42 |
| l. lat. inf. | 25— 29 | 26.76 | 1.48 |
| l. lat. sup. | 22— 27 | 23.75 | 2.04 |
| radii D | 9— 10 | 9 43 | 0.49 |
| radii A | 7— 8 | 7.71 | 0.45 |
| radii V | 8 | 8.00 | 0.00 |
| radii P | 12— 13 | 12.14 | 0.35 |
| sp. br. | 17— 19 | 17.71 | 0.88 |
| app. pyl. | 69— 99 | 73.57 | 11.72 |

the samples of *Salmo trutta farioides* from the Pećka Bistrica, we established considerable smaller number of longer and thicker pyloric appendices (appendices pylorici). The number of pyloric appendices of the analyesd individuals of *Salmo trutta farioides* from the Krka 34—50, the Neretva 35—47, the Radika 41—58, Skadar Lake 35—49 (Karaman, 1937; Ivanović, 1937) and the Pećka Bistrica (32—34) is considerable smaller in comparison to *S. trutta* m. *fario* from the Resava 59—99, as well as to the number (40—100, M = 65.33), which was cited by Vuković (1971) for *Salmo trutta* m. *fario* from the other waters of Yugoslavia. The number of pyloric appendices at the population of stream trout from the Pećka Bistrica is relatively stable and the growth of the body of fish has no influence to its variability. There are almost no differences between the individuals from the Pećka Bistrica and the Resava (Tab. 1) in the morphometric characters except for the depth of a head, the size of eye, the size of V and depth of A fins

It is characteristic that the body proportions of Salmo trutta farioides can be changed considerably with the increase of the body length. This was well illustrated by the data of Sidorovski (1955), obtained by the comparison of individuals from the Radika river, sized 150—275 mm and individuals from Mavrovo Lake sized 280—435 mm. These results showed that the length of head, predorsal and postdorsal distance and the depth of body diminished considerably with the increase of the body length. This tendency appears especially when the size of eye is considered The individuals 150—275 mm long have

---

*The figures 3—6 will be found at the end of this issue.



**Figs.** 1—2. Pyloric appendices: 1 — ***S. trutta*** m. *fario* L. from the Resava river, 2 — *S. trutta farioides* Kar. from the Pećka Bistrica.

considerable larger eyes (M = 23.12—23.81) than the individuals sized 280—435 mm) M = 15.76—16.53 % of the length of head). Th esexual dimorphism appears also in some of these characters. Heads of males are larger and wider in relation to the females with larger preocular distance and smaller diameter of eye.

The parallel comparison of morphological characters showed that *Salmo trutta fariodes* differred from Salmo trutta m. fario, also by smaller number of longer and thicker pyloric appendices (Figs. 1, 2), somewhat smaller number of scales above and below lateral line, with the larger depth of head, the smaller eyes which can be placed 4.2—4.9 (the average 4.5) times in to the the length of a head, 2.1—2.6 times into the postocular space or 1—1.4 times into the interocular space, with higher A fins and with the larger abdominal fins Except for these details the following diagnosis and description are helpful in determination of belonging to *S. trutta farioides:*

D IV 8—10 (11); A (III) IV 7—9; V I 7—8; P I 11—13; 1.1. 20—26—106—128 — 18—23; Sp br. 17—19; App. pyl. 32—58.

Table 2. Plastic and meristic characters of the *Salmo trutta farioides* / P. Bistrica (Drim Syst.) TL 795 – 184.5 mm, our values; Radika R. (Sidorovski, 1955), TL 150 – 275 mm; S. Lake (Ivanović, 1973), TL 208 – 470 mm

| Charactors | P. Bistrica | | | Radika R. | | | S. Lake | |
|---|---|---|---|---|---|---|---|---|
| | ranges | M | SD | M (males) | M (females) | M | M | SD |
| In % long. corp. | | | | | | | | |
| long. capitis | 24.80 – 27.79 | 26.55 | 1.13 | 21.28 | 20.44 | | 22.80 | 2.35 |
| dist. praedor. | 44.98 – 48.25 | 46.20 | 1.17 | 39.75 | 39.58 | | 40.87 | 1.90 |
| dist. postdor. | 41.44 – 45.31 | 43.95 | 1.43 | 32.86 | 32.47 | | 57.47 | 5.35 |
| dist. praean. | 70.84 – 77.84 | 75.27 | 2.25 | | | | | |
| dist. praeven. | 54.37 – 57.80 | 55.49 | 1.24 | | | | | |
| alt. corp. max | 22.94 – 28.74 | 25.70 | 1.93 | 19.63 | 19.41 | | 19.88 | 2.56 |
| alt. corp. min | 10.58 – 11.00 | 10.72 | 0.15 | 8,45 | 8.51 | | 7.67 | 1.48 |
| long. ped. caud. | 15.99 – 18.27 | 17.10 | 0.79 | | | | 17.92 | 0.98 |
| long. D | 12.03 – 13.75 | 12.78 | 0.61 | 11.70 | 11.63 | | 12.11 | 0.70 |
| alt. D | 18.91 – 22.32 | 20.52 | 1.08 | 13.48 | 12.83 | | 13.99 | 1.07 |
| long. A | 8.60 – 11.63 | 10.08 | 0.78 | 8.17 | 8.52 | | 8.23 | 0.81 |
| alt. A | 16.26 – 19.24 | 18.01 | 1.02 | 11.55 | 11.45 | | 11.75 | 1.59 |
| alt. P | 19.46 – 22.48 | 20.84 | 1.05 | 14.32 | | | 14.32 | 1.85 |
| alt. V | 15.89 – 16.83 | 16.26 | 0.32 | | | | 12.09 | 1.80 |
| long C | 19.38 – 22.63 | 20.91 | 1.28 | | | | | |
| In % long. cap. | | | | | | | | |
| alt. capitis | 61.56 – 66.75 | 64.23 | 1.65 | | | | | |
| dist. praeoc. | 24.22 – 28.46 | 27.32 | 1.57 | 28.12 | 27.75 | | 30.56 | 1.44 |
| dist. postoc. | 52.59 – 56.87 | 54.24 | 1.57 | 53.51 | 54.51 | | 53.18 | 2.59 |
| diamet. oculi | 21.11 – 23.89 | 22.21 | 0.95 | 23.12 | 23.81 | | 17.67 | 1.30 |
| dist. interoc. | 25.95 – 29.47 | 28.28 | 1.31 | 29.24 | 29.70 | | | |
| lin. later. | 107 – 120 | 113.00 | 4.97 | 106 – 128 | | 118.47 | 129.66 | 15.51 |
| lin. lat. inf. | 20 – 26 | 23.75 | 2.28 | | | | 20.23 | 2.35 |
| lin. lat. sup. | 18 – 23 | 20.50 | 1.80 | | | | 20.66 | 2.36 |
| radii D | 8 – 10 | 9.00 | 0.76 | | | | 10.00 | 0.57 |
| radii A | 7 – 9 | 8.00 | 0.53 | | | | 8.00 | 0.58 |
| radii V | 7 – 8 | 7.86 | 0.35 | | | | | |
| radii P | 11 – 13 | 12.17 | 0.69 | | | | | |
| sp. br. | 17 – 19 | 18.00 | 0.76 | | | | 16.50 | 1.71 |
| app. pyl. | 32 – 38 | 36.60 | 3.32 | | | 48.20 | 42.66 | 5.80 |

The body is compact and relatively high. In the samples 79.5—184.5 and 150—275 mm, the predorsal distance is in average contained 46.20—39.66% in hte standard length of body and is larger than the postdorsal one. The length of head diminished with the increase of the length of a body and in the same samples amounts in average 20.80—26 55% of the standard length of body. It is aproximately equal to the maximal depth of body (M = 25.70—19.52%). The preocular distance, which shows the sexual dimorphism, increases with the age of individuals. It makes in average 27.32—37.93% of standard length of body. The size of eye in averagemakes22.21—23.46% of the length of head. The upper jaw reaches the back edge of eye. It gradually gets narrower towards the back end. The teeth on the vomer are placed in the zig-zac line. The caudal fin is carved. The colour of body varies a lot. On the sides of head, there are black spots, and one the sides of body there are black and red spots of different sizes. In the samples larger than 150 mm, the red spots are surrounded with the bright edge.

### *Salmo marmoratus* Cuvier, 1817 (Fig. 4)

This fish was described from the waters in Lombardy (Iatly). Heckel and Kner (1858) have recognized the sample of this species from the Sala river (Isonzo basin) as the independent species *Salar genivittatus*. Steindachner (1882) found the sample of this species in the Neretva, but he did not consider it an independent one, but a variety of the stream trout. Karaman (1926) established its presence in the Neretva but in contrast to Steindachner he considered it an independent species *Trutta genivittata*. Later, Karaman (1932), stated the presence of this species in the Zeta, a tributary of Skadar Lake. Delphino (1935) found this fish on the Albanian side throughout the whole course of the Drim river. Karaman (1937), on the basis of the data given by Grindelli (1936), accepted that the populations of this fish from the Soča and Neretva belonged to the species *Salmo marmoratus*. Taler (1950) presented the data on its presence in our waters, and Drecun (1962) found it in the Skadar river basin. M. Karaman (1966), however, studying the trouts of the south of Europe, did not confirm the presence of this species in the Drim system. Tortonese (1970) summing up the results of the investigations on this fish in the waters of Italy, recognized it as a subspecies: *Salmo trutta marmoratus*. Ivanovic (1973), Dorofejeva (1974), as well as Bianco (1988) recognized it as independent species.

Studying the ichthyofauna of the Beli Drim river basin we have ascertained the presence of *Salmo marmoratus* in the upper part of salmonidal and barbel region of the Beli Drim in the lower course of its tributary Miruša. Our data, obtained through the analysis of morphological characters, could be compared with those of Ivanović (1973) which are related to the samples of this species from Skadar Lake (Tab. 3), as well as with individual and summary data from literature given by other authors (Karaman, 1926; Gridelli, 1936; Tortonese, 1953 54; Pomini, 1939; Somani, 1948, 1966; Kosorić et Vuković, 1969; Dorofejeva et Seratlić-Savić, 1970; Vuković et Ivanović, 1971, and Bianco, 1988). These data are somawhat different from those-given by Karaman (1924), who for this trout from the Neretva gave a diagnosis: D IV 10; A III-IV 8; V II 8; P I 14; C 19; 1 1. 18—22—120—125—20—24; App. pyl. 41—47. The deviation in the number

Table 3. Plastic and meristic characters of the *Salmo marmoratus* from the Miruša river and the Skadar Lake

| Characters | Miruša (Drim Syst.) TL 323—387 mm<br>min—max | M | SD | Skad. Lake (Ivanović, 1973) TL 295.5—426.3 mm<br>min – max | M | SD |
|---|---|---|---|---|---|---|
| In % long. corp. | | | | | | |
| long. capitis | 25.55—26.30 | 25.92 | 0.37 | 23.40—27.16 | 25.26 | 1.95 |
| dist. praedorsalis | 47.48—47.72 | 47.60 | 0.12 | 46.04—54.07 | 50.04 | 4.08 |
| dist. postdorsalis | 41.49—42.73 | 42.11 | 0.62 | 41.57—42.26 | 41.94 | 0.73 |
| dist. preanalis | 72.60—74.78 | 73.69 | 1.09 | | | |
| dist. praeventralis | 51.67—54.00 | 52.83 | 1.16 | | | |
| alt. corp. max | 23.10—28.11 | 25.62 | 2.48 | 20.75—21.15 | 20.95 | 0.20 |
| alt. corp. min | 9.20—10.92 | 10.06 | 0.86 | 7.92— 8.14 | 8.02 | 0.20 |
| long. ped. caudalis | 16.62—18.11 | 17.36 | 0.74 | 14.70—18.86 | 16.81 | 2.08 |
| long. D | 11.69—13.17 | 12.47 | 0.74 | 11.70—12.07 | 11.89 | 0.20 |
| alt. D | 15.13—17.75 | 16.44 | 1.31 | 12.49—12.83 | 12.66 | 0.17 |
| long. A | 7.57— 7.61 | 7.59 | 0.02 | 10.23—10.94 | 10.58 | 0.48 |
| alt. A | 14.39—16.72 | 15.55 | 1.16 | 10.19—12.33 | 11.25 | 0.80 |
| alt. V | 13.71—17.07 | 14.79 | 1.08 | 10.24—10.57 | 10.38 | 0.36 |
| alt. P | 15.87—18.36 | 17.36 | 1.49 | 12.83—13.67 | 13.25 | 0.42 |
| In % long. capitis | | | | | | |
| altitudo capitis | 62.55—67.66 | 64.95 | 2.70 | | | |
| dist. praeocularis | 31.24—32.20 | 31.72 | 0.48 | 27.42—28.98 | 28.19 | 0.95 |
| dist. postocularis | 55.07—56.10 | 55.58 | 0.51 | 54.84—59.71 | 57.27 | 2.44 |
| diameter oculi | 15.33—16.24 | 15.78 | 0.45 | 13.72—17.74 | 15.72 | 2.05 |
| dist. interoculi | 32.52—33.42 | 32.97 | 0.45 | | | |
| linia lateralis | 112—115 | 113.50 | 1.50 | 120—125 | 122.50 | 2.50 |
| linia lat. inf. | 22— 25 | 23.50 | 1.50 | 22— 25 | 23.50 | 1.50 |
| linia lat. sup. | 20— 24 | 22.00 | 2.00 | 24— 26 | 25.00 | 1.00 |
| radii D | 10— 11 | 10.50 | 0.50 | 10 | | |
| radii A | 8 | | | 8 | | |
| radii V | 8 | | | | | |
| radii P | 12 | | | | | |
| sp. br. | 18— 20 | 19.00 | 1.00 | | | |

of pyloric appendices is especially conspicuous since there were only 24 pyloric appendices in two samples from the Miruša river (the Beli Drim river basin).

Except for some details, this species can be incontestably differentiated from other trouts by the marble coloured head and the characteristic color of the trunk, relatively small eyes which can be placed 5.6—7.5 into the length of the head (average 6.4 times), and 3.1—4.3 (average 3.6 times) into the postocular space In the interocular space the eye can be placed 1 7—2.2 times. The preopercular distance is approximately equal to the interocular distance and can bé placed 3.1—3.6 times into the length of a head.

The more detailed comparative analysis of the characteristics of samples fro mthe Beli Drim river basin Skadar Lake and the Neretva river made the closer diagnosis and description of species *Salmo marmoratus*:
D IV 10—11; A III (IV) 8; V 1 8; P I 12—14; 1.1. 22—25—112—125—20—24 (26); Sp br. 18—20.

The body grows to large dimensions. In the samples of 296.5—426.3 mm the predorsal distance is contained 46.04—54.07%. M = 48.82% in the standard length of body and is larger than the postdorsal distance (41.49—42.73%, M = = 42 01%). The maximal depth of body is contained 20.75—28.11%, M = = 23.29% in the standard length of body. The minimal body depth ammounts 7.92—10.92%, M = 9.04%. The length of head is contained 23 40—27.16%, M = = 25.60% in standard length of body. The maximal dopth of head ammounts 62.25—67.66% of its length. The preocular distance is contained 27 42—32.20%, M = 29.96% in the length of head. It is somewhat shorter than the interocular distance (32.52—33.42%. M = 32.97%). The size of eye is relatively small and ammounts 13.72—17.74%, M = 15.76% of the length of head. The upper jaw surpasses the back edge of eye. Its width varies strongly, especially at its end. The teeth on the vomer are in one row, in the zig-zag line. The caudal fin is insignificantly carved. The color of body is strongly variable, but the head is always similarly marble coloured. In younger samples there were a few dark spots on the sides of head. while on trunk there were dark spots and very rarely red spots without light edge.

### *Salmo dentex* Heckel, 1851 (Fig. 5)

Heckel (1851) described this species on the specimens from the waters in Dalmatia (the Krka, the Cetina) but he found it in the Neretva as well. Doflein (1918). Drenski (1922) and Karaman (1924) were wrong when citting it for Ohrid Lake. Karaman (1932, 1936) confirmed his own data from 1924 on the occurrence of this species in the waters of Krka, Cetina and Livno as well. Karaman (1937) rejected the data by Gridelli (1935, 1936) who described this species as *Salmo fario* or as a hybrid *Salmo marmoratus* × *Salmo fario*, giving more detailed description on the specimens from the Krka. Drecun (1962) found this species in the adriatic river basin in Montenegro. Later, Kosorić and Vuković (1966) found it in the river Buna. Ivanović (1973) did not accept the opinion that *Salmo dentex* could be a subspecies of the stream trout describing the specimens from Skadar Lake in detail.

We compared our data obtained by the analysis of the specimens from Skadar Lake with the data given by Ivanović (1973) for the specimens from the same lake (Tab. 4) and with those given by Karaman (1937) for the

Table 4. Plastic and meristic characters of the *Salmo dentex* from the Skadar Lake

| Characters | Skadar Lake TL 300–311 mm | | | Skad. Lake (Ivanović, 1973) TL 307–529 mm | | |
|---|---|---|---|---|---|---|
| | min–max | M | SD | min–max | M | SD |
| In % long. corp. | | | | | | |
| long. capitis | 22.98–24.21 | 23.61 | 0.63 | | 22.90 | 1.73 |
| dist. praedorsalis | 42.38–43.69 | 43.03 | 0.65 | | 44.44 | 2.34 |
| dist. postdorsalis | 43.02–43.14 | 43.08 | 0.06 | | 45.33 | 2.25 |
| dist. praeanalis | 73.96–78.61 | 76.28 | 2.33 | | | |
| dist. praeventralis | 53.21–55.21 | 54.21 | 1.00 | | | |
| alt. corp. max | 24.39–24.53 | 24.46 | 0.07 | | 23.85 | 3.31 |
| alt. corp. min | 9.05– 9.69 | 9.37 | 0.32 | | 9.17 | 0.55 |
| long ped. caudalis | 17.74–20.14 | 17.82 | 0.09 | | | |
| long. D | 11.85–12.79 | 12.32 | 0.47 | | 12.73 | 0.75 |
| alt. D | 14.64–15.72 | 15.18 | 0.54 | | 14.00 | 1.71 |
| long. A | 8.38– 9.87 | 9.12 | 0.74 | | 7.95$^{6}$ | 0.71 |
| alt. A | 13.39–14.04 | 13.71 | 0.32 | | 11.91 | 2.42 |
| alt. V | 12.28–12.41 | 12.34 | 0.06 | | | |
| alt. P | 16.45–16.90 | 16.67 | 0.22 | | | |
| long. C | 19.09–20.11 | 19.60 | 0.57 | | | |
| In % long. capitis | | | | | | |
| altitudo capitis | 70.89–73.89 | 72.39 | 1.50 | | | |
| dist. praeocularis | 28.05–28.37 | 28.73 | 0.34 | | 31.62 | 2.29 |
| dist. postocularis | 54.84–59.58 | 57.21 | 2.37 | | 56.02 | 2.26 |
| diameter oculi | 15.84–17.40 | 16.62 | 0.78 | | 15.12 | 1.67 |
| dist. interoculi | 31.52–33.99 | 32.75 | 1.23 | | | |
| linea lateralis | 117–120 | 118.50 | 1.50 | 114–123 | 118.10 | |
| linea lat. inf. | 25– 26 | 25.50 | 0.50 | 18– 21 | 19.25 | |
| linea lat. sup. | 19– 21 | 20.00 | 1.00 | 18– 25 | 20.75 | |
| radii D | 10 | | | 10 | | |
| radii A | 7– 9 | 8.00 | 1.00 | 7– 8 | | |
| radii V | 8 | | | | | |
| radii P | 12– 13 | 12.50 | 0.50 | | | |
| sp. br. | | | | 17– 21 | 18.60 | |
| app. pyl. | | | | 39– 52 | 45.50 | |

specimens from the Krka, where in addition to everything else he pointed out that the number of pyloric appendices varied from 35 to 45 in this fish. Certain deviations in these data could be ascribed to subjective mistakes, but to the different number of the analysed specimens as well. *Salmo dentex* is especially distinguished from other salmonides by its postdorsal distance which is nearly equal to the predorsal one or even larger. The head and body are sprinkled by small dark spots especially the upper part of body. The head is deep with a bulge in the shape of vertical crest in the interocular space. The depth of a head can be placed 1.5 times into its length. The eye could be placed 3.2—4.5 times (average 3.6 times) into the postocular distance and 1.5—2 times into the interocular distance. This characteristic is similar to *Salmo marmoratus* but different from stream trouts. Interocular distance could be placed 2.9—3.2 times into the length of a head. This fish has extremely strong elongated teeth. The established data make closer diagnosis and the description of *Salmo dentex* possible: D IV 9—10; A III-IV 7—8; V I 8· P I 11—13; l.l. (18) 21—27—114—123—18—25; Sp. br. 17—21; App. pyl. 35—52.

The body is elongated, proportionally flat. In the specimens of 300—311 and 307—620.7 mm the average maximal depth of the body is 24.46—23.85% and minimal 9.37—9.17% of the standard body length. Predorsal distance (43.08—44.44%) is approximately equal to the postdorsal one (43.08—45.33%) or somewhat less. The head is proportionally deep amounting in average 72.39% of the head length. On the forehead there is a bulge in the shape of vertical crest. The length of head decreases with the increase of the body length amounting 23.61—22.90% of the body length. The similar tendency of decrease is found also in the diameter of the eye which in average amounts 16.2—15.1% of the head length. Postocular distance amounts in average 57.12—56.02% of the head length. The upper jaw reaches behind the eye. It has extremely strong teeth placed on nerly all bones of oral cavity. The teeth on the vomer have divergent peaks lined up zig-zag. It has a proportionally flat dorsal fin. The caudal fin is moderately carved. The sides of the body are sprinkled by small black spots among which a small number of red spots could be found.

### *Salmo letnica* Karaman, 1924

Doflein (1918) identified the Ohridan trout "letnica" as the species *Salmo dentex*. Drenski (1922) made a mistake naming it *Trutta ohridana*. Karaman (1924) as well Doflein. true Ohridan trout called *Trutta dentex*. At the same time Karaman temporarily pointed out another species naming it *Trutta letnica* and considering it sterile specimen of the wrongly described species *Trutta dentex*. Later Karaman (1926) partly changed his first opinions describing the Ohridan trout, which had previously named *Salmo dentex*, as an independent species *Trutta balcanica*. Berg (1932) noted that the species *Salmo letnica* included not only *Trutta balcanica* but the species *Trutta letnica* as well. These two Ohridan forms should therefore be identical.

Studying the Ohridan trout *Salmo letnica*, Stefanović (1948) described three subspecies: *S. letnica typicus* ("pešta trout"), *S. letnica balcanicus* (trout from Struga) and *S. letnica aestivalis* (summer trout). In addition to everything else, Poljakov et al. (1958) stated *Salmo letnica letnica* and *S. letnica lumi* for Ohrid Lake. M. Karaman (1966) confirmed the validity of the species *S. letnica*, considering the described forms: *balcanicus*, *aestivalis* and *lumi*, as we have already pointed out, only a part of one population, or local micropopulation. At the same time he pointed out that the form "letnica" was one vegetative stage in the life cycle of the trout when the individuals were preparing for spawning intensively. According to him this vegetative phase appears between two spawning periods lasting a longer time, a whole year.

In the literature data on the described forms of the Ohridan trout it is pointed out that "pešta trout" and "summer trout" differ insignificantly in their morphological characters. They differ more significantly during the periods of spawning: while "pešta trout" spawns in January and February, "summer trout" spawns in May, June and July. Both forms live in the north-east and east part of the lake. "Trout from Struga" differs more clearly from them by its body characteristics; tihs species lives in the north-west part of the lake, the one which flows out. This trout lives both in the lake and in the water flows of Drim and spawns from October to January. It was also pointed our that "pešta trout" and "summer trout" had some characteristics of lacustric forms (larger body depth, larger eyes etc.) and that "trout from Struga" had the characteristics of the reophilic forms (smaller body dopth, smaller eyes etc.) which could be ascribed to the influence of their environment and to the great plasticity of their morphological characters as well.

According to our observations, the spawning of the specimens of the same population of the Ohridan trout, as well as of other species of fishes in Ohrid Lake (Šorić, 1984), does not occur in all the sexually mature specimens at the same time, which means that a lot of specimens reach their final stage of maturity at the end of normal spawning season or even later. After that later spawning, their gonades are in the process of resorption and regeneration for longer time. These specimens omit probably only one spawning period, so that some closer causes of this phenomenon should be searched for in the specific characteristics of these specimens, and in the nature of the effects of ecological factors as well. These specimens of the Ohridan trout were probably marked as "letnica".

The process of gametogenesis in all its phases in the Ohridan trout was followed by intensive hormonal activities and the changes of physiological processes and the metabolism in general. These were the causes of the changes in the proportion of head, body, fins and the structure of skin including the pigmentation in general. All these caused differences in the specimens of the same trout more or less. Different spawning periods of the Ohridan trout specimens, and the different hydrological regime of the time and space in the lake caused the differences in the choice of spawning places of the specimens of the ohridan trout as well.

This Ohridan trout is characterized by following characteristics:
D IV 8—9; A IV 7—9; V II 8; P I 11—13; 1.1. 21—27—108—122—21—24; Sp. br. 19—25; App. pyl. 47—85; Vert. 54—60.

The body is moderately compact. The predorsal distance is larger than postdorsal one. The maximal body depth amounts 18—30% of the total body length. The head is relatively narrow and its length amounts 18—25% of the body length. The snout is elongated and the whole preocular space amounts 24—35% of the head length. The diameter of eye could be placed 16—25% into the length of head. The lower jaw reaches the back margin of eye, and even more beyond in the older specimens. The teeth on the upper as well as on the lower jaw are more strongly developed in the period of sexual maturity. The body is sprinkled by black and red spots whose number and arrangement vary very much. The red spots are usually arranged along the side line.

### *Salmothymus ohridanus* (Steindachner, 1892) (Fig. 6)

In 1892. Steindachner described this fish as separate endemic species in the waters of Ohrid Lake and called it *Salmo ohridanus*. Berg (1910), however, classified it in the genus *Salmothymus*. Later, wrong design for this species appeared such as, *Coregonus fera*, *Coregonus wartmani*, *Trutta ohridana* and *Salmo ohridana* (Drenski, 1922; Doflein, 1918; Karaman, 1924, 1926, 1957). Vladykov et Petit (1930), Thieneman (1950) and Stanković (1959) accepted the opinion of Berg classifying this species into the genus *Salmothymus*. Ladiges et Vogt (1956) designated it as a subspecies *Salmothymus obtusirostris ohridanus*. Hadžišče (1959, 1962) firstly described it as a representative of a new subgenus *Acantholingua*, within the genus *Salmothymus*. Later he classified it as a separate genus and species *Acantholingua ohridana*. M. Karaman (1966) has not accepted the opinion of Hadžišće retaining the primary status for this trout.

Spending some time at Ohrid Lake in 1974, with the Ohridan fishermen we caught a sample of this species which is characterized by: D V 10; A IV 10; V I 12; l. l. 19—110—18; Sp. br. 19. Its morphometrical characteristics, except for the number of spina brch., which deviates from the data given by Karaman (10—11), more or less are appropriate to the ones given by Steindachner (1892), Karaman (1924, 1932), and Hadžišće (1959), according to which the following diagnosis and description is given:
D IV—V 8—10; A IV 8—10; V I 8—9; P I 11—12; l.l. 13—19—105—110—13——18; App. pyl. 34—49

The head is proportionally small with flat rounded snout. Preocular distance is significantly shorter than the postocular one being nearly equal to the interocular distance. The eye is relatively large and can be placed 3.8—4.2 times into the length of the head and 1.9—2.4 times into the postocular distance. The forehead is flat. Transverse in the level of eye there is a small bulge. The upper jaw is short and wide in its back end reaching 2/3 of the eye. In younger specimens it reaches only the middle of the eye or even less. The mouth is small, the teeth on the jaws are weaker than the teeth on vomer and palatal bones. Between the teeth there are small bulges. The body is silver-coloured with a few dark and very rarely red spots.

It is considred that this species evolved in Ohrid Lake from the old form *obtusirostris*, which appeared in Ohrid Lake by the Drim system from the West-Balkan refuges. This can be proved by the presence of *Salmothymus obtusirostris zetenzis* in the Skadar Lake river basin which communicates with Ohrid Lake through the Drim system.

### *Salmothymus obtusirostris zetenzis* (Hadžišće, 1962)

Karaman (1932) described this softlipped trout from the river Zeta (a tributary of Skadar Lake) as *Trutta obtusirostris letnica*. which he considered the same as *Trutta letnica* which he himself described in Ohrid Lake. Later Karaman (1957) cited it as a *Salmo obtusirostris letnica*. Hadžišće (1962), analyzing the head bones of the species of the genus *Salmothymus*, described this trout as a new species giving it a name *Salmo zetenzis*. Drecun (1962) described this fish in the Skadar Lake river basin as *Salmothymus obtusirostris zetenzis*. M. Karaman (1966) retained the same status for this fish (*S. obtusirostris zetenzis*) finding out that its description stands between the forms *obtusirostris* and *ohridanus*. Ivanović (1973) gave more precise description for this subspecies on two specimens from which we point out the following meristic characters: D IV 10; A IV 8—9; 1.1. 18—19—114—18.

Unfortunatelly, I have not had the opportunity to find any specimens of this fish. However, comparing the characteristics of the specimens of the species *Salmothymus ohridanus* from Ohrid Lake and the formerly established data for this species with the data given by Ivanović (1973) relating to the specimens *S. obtusirostris zetenzis* from the river Zeta, I have found that they are very close. It is apparent, however, that comparative morphological analysis is necessary for any better information on these fishes.

## SUMMARY

Salmonids in the Ohrid-Drim-Skadar system belong to the genera of *Salmo* and *Salmothymus*. The genus *Salmo* have its representatives: *Salmo trutta farioides* in the Skadar Lake river basin, in the Beli Drim river basin, in the river Radika and n Mavrovo Lake (the Crni Drim river basin); *Salmo marmoratus* in Skadar Lake river basin, the Beli Drim and in its tributary Miruša; *Salmo dentex* in the Skadar Lake river basin and *Salmo letnica* in Ohrid Lake.

The genus *Salmothymus* is represented by the species *Salmothymus ohridanus* in Skadar Lake and *Salmothymus obtusirostris zetenzis* in the river Zeta, a tributary of Skadar Lake.

The results of up-to-date investigations, as well as our research have made closer diagnosis and description of each species and subspecies possible. The formerly established characteristics of the species were confirmed. In comparison with the former diagnosis and descriptions, the wider range of variety in the number of scales in the lateral line and above and below it, in the number of rays of fins, in the number of branchiospinae in the number of pyloric appendices and in the differences in their length and width, were established in *Salmo trutta farioides, S. marmoratus, S. dentex* and *Salmothymus ohridanus*.

Neglecting a lot of details for all the species, in the body proportions we found the characteristic relationships in the diameter of eye and the lengths of head, in the postorbital and the interorbital space in the relationship of the length of the predorsal and postdorsal distances, in the range of the upper jaw in relation to the eye, as well as in the pigmentation of the head and trunk.

## LITERATURE

Arbocco G., 1966: I Pesci d'acqua dolce della Liguria. *Ann. Mus. St. Nat. Genova*, 76: 137—171.

Banarescu P., 1964: Fauna Republicii Populare Romine. Pisces-Ostechthyes, 13, 959 pp., Bucuresti.

Banarescu P., 1980/81: Ihtiofauna bazinului Crisurilor in cadrul general al ithiofaunei bazinului Dunarean. *Folia naturae Bihariae*, 8—9: 476—481.

Berg L. S., 1910: Vorläufige Bemerkungen über die europäisch-asiatische Salmoninen, insbesondere über die Gattung Thymallus. *Ež. Z. M.*, 15: 2—3.

Berg L. S., 1932: Übersicht der Verbreitung der Süsswasserfische Europas. *Zoogeographica*, 1: 107—208.

Bianco P. G., 1988: I Pesci d'acqua dolce d'Italia· note su un recente contributo. *Atti Soc. it. Sci. nat. Museo civ. Stor. nat. Milano*, 129 (2—3): 146—158.

Cuvier G., 1817: Le Règne animal distribué d'après son organisation. Paris, 1: 256.

Delpino I., 1935: Diffusione e distribuzione in Italia della Trutta genivittata Heck. *Boll. Pesca, ecc. Roma*, 11, 2: 532.

Doflein F., 1918: Das Macedonien .Jena.

Dorofejeva E. A., Seratlić D, 1970: Osteološke karakteristike Salmo marmoratus Cuvier. III simpozijum jugoslovenskog ihtiološkog drušstva. Kotor.

Dorofejeva E., 1974: Systematic relations of salmons of the Genus Salmo. *Ichthyologia*, 6, 1: 27—36.

Drecun Dj., 1962: Rasprostranjenje i popis slatkovodnih riba Crne Gore. *Hydrobiologia Montenegrina*, 2, 1: 8.

Drenski P., 1926: Neue und seltene Fische aus Bulgarien. *Trav. Soc. Bul. G. Sci. Nat. Sofia*, 12: 121—150.

Gridelli E., 1935: Le Trote della Venezia Giulia. *Note Ist. Biol. Mar. Rovigno*, 16.

Gridelli E., 1936: I Pesci d'aqua dolce della Venezia Giulia *Boll. Soc. Adr. Sci. Nat., Trieste*, 35: 7—140.

Grubić G., Janković D., i Mitrović-Tutundžić V., 1982: Uticaj zagadjivanja suspendovanim materijama rudnika uglja "Rembas" na ihtiofaunu Resave, pritoke Velike Morave. *Acta Biol. Yugoslav. Ekologija*, 17, 1: 39—53.

Hadžišće S., 1959: Zur Kenntnis des Salmothymus ohridanus (Steindachner) (Pisces, Salmonidae). Vortrag am XIV. Kongr. der intern. Verein. Limnol., Wien.

Hadžišće S., 1962: Zur Kenntnis der Gattung Salmothymus Berg, zugleich ein Beitrag zur Systematik der Familie der Salmoniden (Pisces). *Izdanija, Skopje*, 3, 2: 39—50.

Heckel J., 1851: Die Störarten der Lagunen bei Venedig. *Sitzb. Akad. Wiss. Wien*, 7, 4: 130.

Heckel J., Kner R., 1858: Die Süsswasserfische der Österreichischen Monarchie mit Rücksicht auf die angrenzenden Lander. Pp. 388, Leipzig.

Hrženjak T., Ehrlich I., 1981: Lipidi u salmonida u vodama nacionalnog parka Plitvička jezera. *Acta Biol. Yugoslavica — Ekologija*, 16, 2: 133—140.

Ivanović B., 1973: Ichthyofauna of Skadar Lake. Biological Station. Pp. 146. Titograd.

Jankov J., Živkov T., 1988: Maturing and size-sex ratio of the brown trout populations (Salmo trutta fario L.) in the main trout rivers of Bulgaria. *Hydrobiology*, 32: 68—85.

Karaman S., 1924: Pisces Macedoniae. Pp. 90, Split.

Karaman S., 1926: Salmonidi Balkana *Glasnik Skop. naučnog drušstva*, 2, 1—2: 1—16.

Karaman S., 1932: Novi prilozi poznavanju naših salmonida. *Ribarski list*, 7, 9—10: 3.

Karaman S., 1933: Prilozi ihtiologiji Crne Gore. *Ribarski list*, 8, 9—10: 3.

Karaman S., 1937: Beitrag zur Kenntnis der Süsswasserfische Jugoslaviens. *Glasnik Skop. naučnog drušstva, 18*: 131—139.

Karaman S., 1957: Pastrmke reke Radike. *Folia Balcanica*, 1, 10: 1—14.

Karaman M., 1966: Beitrag zur Kenntnis der Salmoniden Südeuropas. *Hydrobiologia*, 28, 1: 1—41.

Kosorić Dj., Vuković T., 1966: Ribe rijeke Bune. *Glasnik zem. Muz. Prirodne nauke*, 5· 179—190.

Kosorić Dj., Vuković T., 1969: Ispitivanja mogućnosti hibridizacije salmonidnih vrstva sliva Neretve. *Ichthyologia*, 1, 1: 57—67.

Ladigens W., Vogt D., 1965: Die Süsswasserfische Europas. Paul Parey. Pp. 250, Hamburg und Berlin.

Mihajlova L, 1965: Untersuchungen über die Fischfauna des Struma — Flusses. *Acad. Bul. Sci.*, 19: 55—71.

Oliva O., Hrabě S., Lác J, 1968: Stavovce Slovenska. SVA., 1: 390 pp. Bratislava.

Poljakov G. D., Filippi N. D., Basho K., Hysenaj A., 1958: Peshqit e shqiperise. Universitet Shtetiror i Tiranés. Pp. 286, Tirana.

Pomini F. P., 1939: Fenotipi e genotipi nei Salmo italiani. *Scientia Genetica*, 1: 208—218.

Sidorovski M., 1955: Nekoi morfološki karakteri na pastrmkite od Mavrovskoto ezero i reka Radika. *Izdanija Skopje*, 135—147.

Sommani E., 1948: Sulla presenza del Salmo fario L. e del S. marmoratus Cuv. nell'Iatlia settentrionale, ecc. Ibid., 3, 1: 3—12.

Sommani E., 1966: La Trota marmorata (Salmo marmoratus Cuv.): suo valore sistematico ed importanza come entità zoologica. *Natura*, 57, 3.

Stanković S., 1937: Markiranje ohridskih riba i pitanje ohridske letnice. *Arh. Min. poljoprivrede*, 4, 6: 3—27.

Stanković S., 1959: Ohridskoto Ezero i njegov živ svet. *Kultura*. Pp. 421, Skopje.

Stanković S., 1960: The Balkan Lake Ohrid and its living World. *Monogr. Biol.* 9, 357 pp. W. Junk, Den Haag.

Stefanović D, 1948: Rasna i ekološka ispitivanja na ohridskim salmonidam. SAN, 38, 207 pp. Beograd.

Steindachner F., 1882: Ichthyologische Beiträge. XII. *Sitzungsb. Akad. Wiss. Wien*, 86: 61—82.

Steindachner F., 1892: Über einige neue and selteen Fischarten aus der Ichthyologischen Sammlung des K. K. Naturhistorischen Hofmuseums. — *Denkschr. d. Kais. Akad. Wiss., math. nat. Kl.*, 59: 357—384.

Šorić V, 1984: Biološka proučavanja zapadnobalkanskog endemita Pachychilon pictum (Heckel et Kner) IV — Ciklične promene polnih žlezda kod Pachychilon pictum. *Acta biol. Yugoslavica — Ichthyologia*, 16, 1—2: 63—76.

Taler Z., 1950: Koji salmonidi žive u Jugoslaviji i koji se uzgajaju. *Ribarstvo Jugoslavije*, 5, 3,4: 58—60.

Thienemann A, 1950. Verbreitungsgeschichte der Süsswassertierwelt Europas. Die Binnengewasser, 18, Stuttgart.

Tortonese E., 1970: Osteichthyes. Fauna d'Italia, 565 pp., Bologna.

Tortonese E., 1953/54: Pesci del Parco Nazionale del Gran Paradiso. *Bull. Ist. Mus. Zool. Univ. Torino*, 4, 6: 96—117.

Vladykov V., Petit G., 1930: A propos des Salmonides du Lac d'Ohrida. *Bull. Mus. Hist. Nat. Paris*, 2: 516—518.

Vuković T., Ivanović B., 1971: Slatkovodne ribe Jugoslavije. Zemaljski muzej Bosne i Hercegovine, 268 pp., Sarajevo.

Received December 4, 1989; accepted March 8, 1990.

## REVIEW

Lima-de-Faria A., 1989: *Evolution without Selection* (Form and Function by Autoevolution). Elsevier, Amsterdam, 37A pp.

24 chapters of the book bring the author's original view on the evolution of organisms of the specialist in "Molecular Cytogenetics" of the University of Lund (Sweden). It is a survey of the author's conception of the evolution, first of all on its molecular, physical and chemical aspects and a discussion of the Darwin's conception of natural selection and the recent "Synthetic Theory of Evolution" based on it, which is one of the most spread evolutionary views recently.

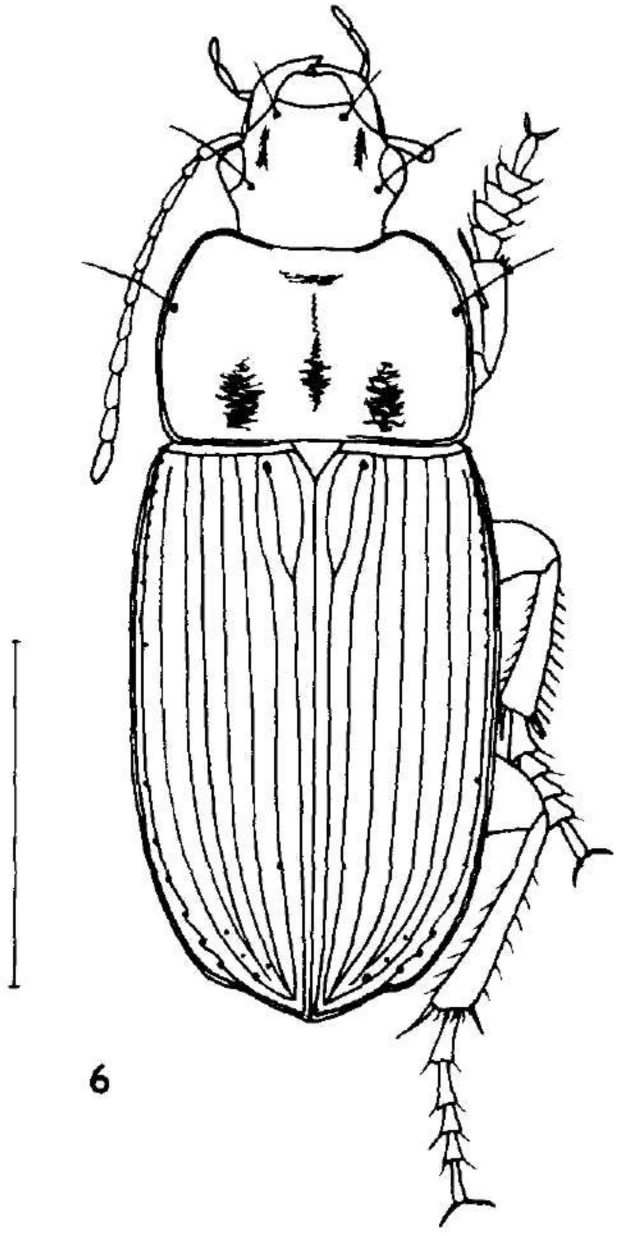
It is interesting to observe that the author, even if he does not mention the book by the prominent Soviet scientist L. S. Berg, 1922: "Nomogenesis or evolution on the basis of regularities" (L. S. Berg, Works on the history of evolution /in Russian/, Nauka Leningrad, 388 pp, 1977), which appeared recently in a new edition, his work based on more than 60 years of new findings, rises from the same principal misunderstanding in that he views his conception of autoevolution as a contradiction of the Darwin's principle of natural selection. (To say nothing of the not very happy term "selfevolution", because evolution is not determined by itself but it is regulated by its environment and its effects on the physical and chemical properties of the organism).

The autor's efforts with which he tries to deny the importance of natural selection are evident from the titles of several chapters already like Ch. 1 "Neo-Darwinism is hindrance to the discovery of the mechanism of evolution". Ch. 2 "The rise and fall of Darwinism and neo-Darwinism". Ch. 26 "Sociobiology must be emancipated from neo-Darwinism (i.e. from natural selection). Ch. 29 "Contrasting autoevolutionism with neo-Darwinism", etc. At the same time the logic of many of his argüments is just unaccessible for biologists engaged with the evolutionary subject. Let me to induce just the following examples from many: "Selection cannot be the mechanism of evolution for the simple reason that it is not a material component of organisms". (With the same right we could deny, of course, mathematics or statistics as being laws of evolution because they are not components of organisms). "Selection has been ascribed the most conflicting properties". (p. 9). (Here it has been ment the stabilizing selection of Schmalgauzen, disruptive selection of Dobzhansky et al., canalizing selection of Waddington, "Orthoselection of White etc., et al). All of them have been well shown by many authors (even if they may be more viewd as individual stages of one and the same selection process than alternative forms of different cases of selection (Cf. Novák, 1978: Natural selection, ... In Proc. Symp. Natur. Selection, Liblice 1978, ČSAV, Praha, 3—36).

Especially unjustified seems to be the author's standpoint in the cases of the common phenomenon of mimicry. According to him the various of cryptic formations (coloration etc.), apsoematic structures (colorations) and imitations of protected species (wasps by flies etc.) may be the results of various physical or chemical agents (p. 277—281 etc.) and they are based in material agreement between the model and the imiting species. It may be viewd as author's merit to emphasize this moment of material agreement, not always sufficiantly respected by advocates of neo-Darwinism. To deny on this basis the role of selection in the often admirable agreements, however, is just incompatible with the scientific approach. It is so more so that there is a lot of experimental evidence on the action of mimicry, as e.g. in the experiments with feeding insectivorous birds with wasps and with naturally and artificially mimeting flies. Similarly, unlike the author's view, there may be no doubts of advantage of cryptic coloration of predators for reaching the prey as e.g. in polar bears or tigers. Similarly many other of his arguments just show that the autor did not pay the necessary attention to the corresponding literature what may be understood, however not excused at a molecular biologist. His logic is therefore often little accessible to researchworkers in the problems of evolution. As to the phenomenon of mimicry, it is to be taken into account, that for the action of selection there is often fully sufficiant if an adaptation protects the given species against only one of its natural enemies. It is also not necessary whether the selecting predator species or other unfavourable agent work nowadays but if it worked in the time when the concerned properties were formed. This means in most corresponding insects no less than 50 to 150 million of years. The absence of the given factor now can thus be no evidence against its participation in selecting of the given structure.

Irrespective of the mentioned lacks in author's approach, the book may be viewd as interesting and stimulating for specialists. Similary as in the case of Berg's nomogenesis and many papers by the recent structuralists, various of the author's observations are to be appreciated, so far they are not put in contradiction with the we well shown scientific findings like in the case of natural selection.

*V. J. A. Novák*



6

Abb. 6 ***Harpalus cisteloides hurkai*** subsp. n., České středohoří, ČSFR, Holotypus. Massstab = 3,5 mm. Orig. K. Rébl.

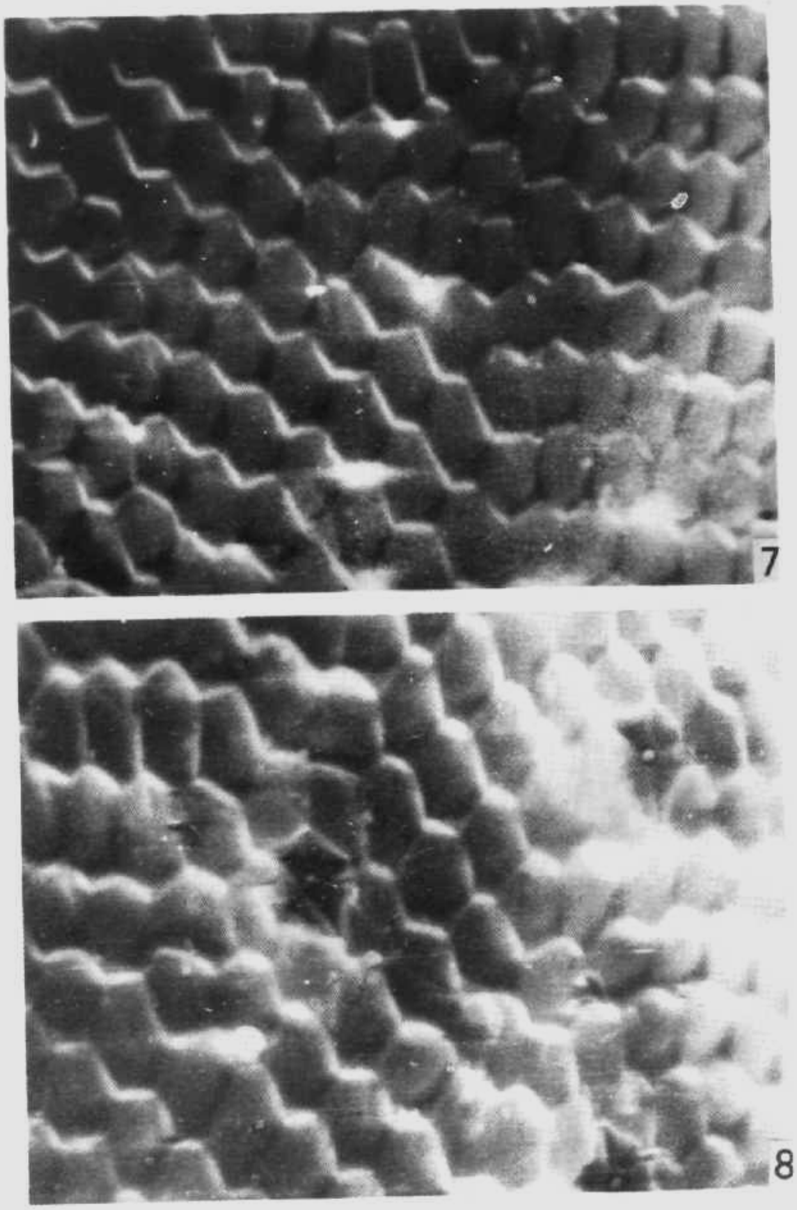
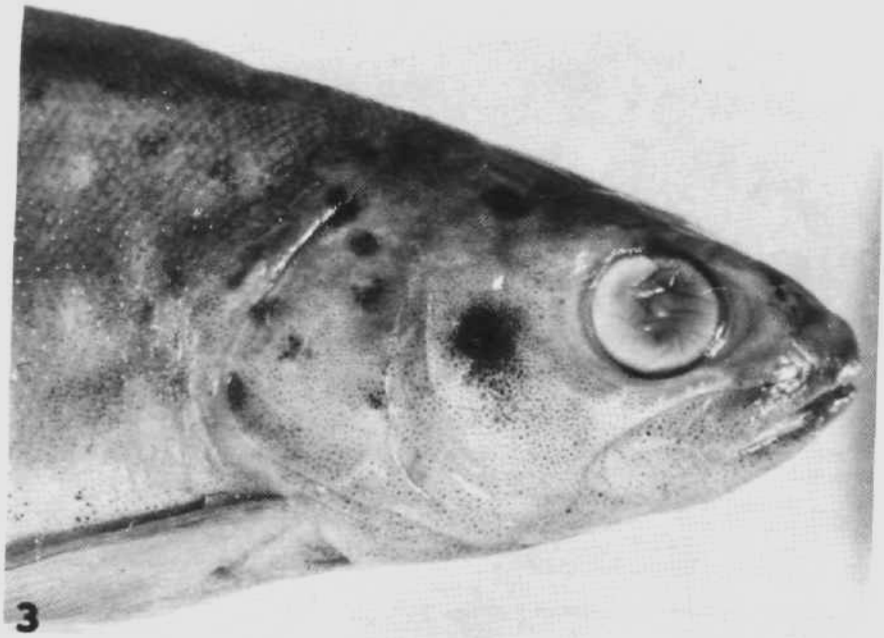
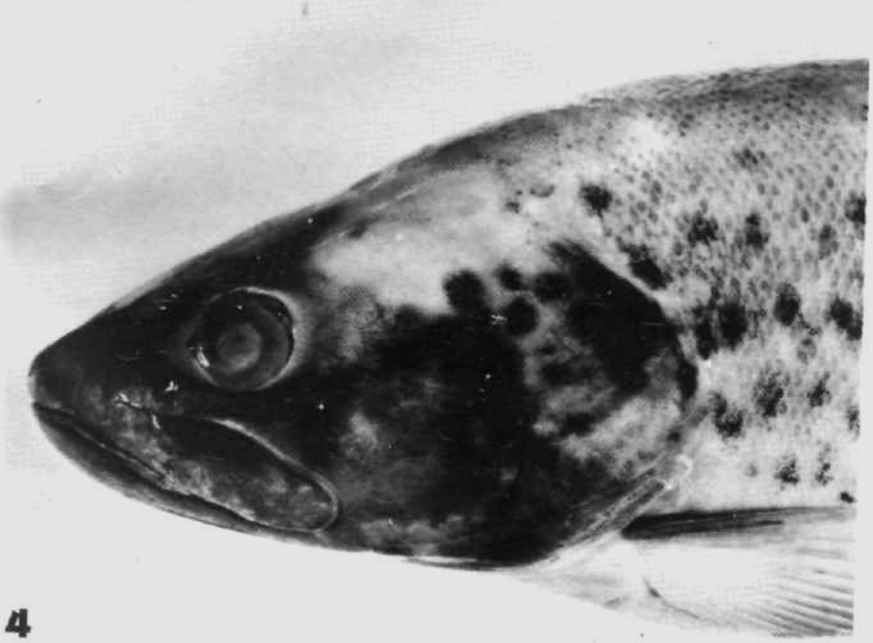


Abb. 7—8. Detail der Mikroskulptur der Flügeldecken, Männchen: 7 — *H. c. cisteloides* Mots., Fergana, Turkestan; 8 — *H. c.* ***hurkai*** subsp. n., České středohoří, ČSFR. 1020mal vergrössert.



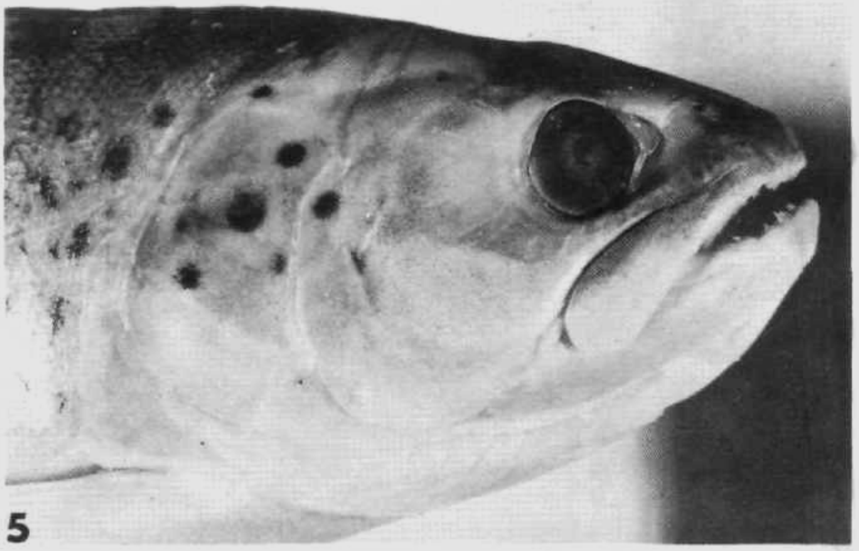
**3**



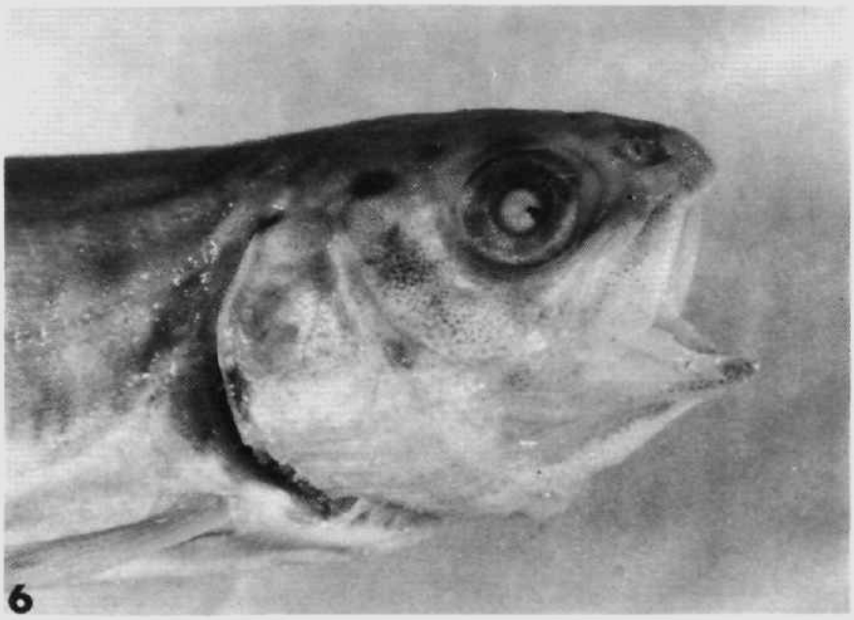
**4**

Fig. 3. *Salmo trutta farioides* Kar. from the Pećka Bistrica river.

Fig. 4. *Salmo marmoratus* Cuv. from the Miruša river.



5



6

Fig. 5. *Salmo dentex* Heckel from Skadar Lake. Fig. 6. *Salmothymus ohridanus* (Steind.) from Ohrid Lake.

# ACTA SOCIETATIS ZOOLOGICAE BOHEMOSLOVACAE

Tom LIV

Editioral Board: K. Hůrka (Editor), K. Absolon (Executive Editor), V. Baruš,
J. Buchar. J. Hrbáček, † J. Kramář, D. Matis, V. Novák, O. Oliva, J. Lom,
B Ryšavý, F. Sládeček, Z. Veselovský, J Vojtek

Prague 1990

ACADEMIA
PUBLISHING HOUSE OF CZECHOSLOVAK ACADEMY OF SCIENCES

## CONTENTS

# Tom. LIV—1990

Divoký V., Půlpán J., Rébl K.: Harpalus (Harpalus) cisteloides hurkai subsp. n. aus der Tschechoslowakei (Coleoptera, Carabidae) . . . . . 241
Dobroruka L. J.: The development and early ontogeny in Aphyosemion gardneri and Aphyosemion scheeli (Pisces: Cyprinodontidae: Rivulinae) . . 81
Dobriyal A. K., Bahuguna A. K., Kotnala C. B., Kumar N. and Singh H. R.: A cose study on the reproductive capacity of common carp, Cyprinus carpio (Pisces: Cyprinidae) from India . . . . . . . . . 91
Ďuriš Z.: Two new species of the palaemonid shrimp genus Periclimenes from the Maldive waters (Crustacea, Decapoda, Palaemonidae) . . . . 1
Hanel L.: The legth and weight growth changes of the common perch (Perca fluviatilis, Pisces, Perciformes) from the Slapy reservoir (Central Bohemia) 246
Hanel L.: The variability of the coloration in the perch (Perca fluviatilis, Pisces Perciformes) from the riverine lake Slapy (Central Bohemia) . . . 161
Hubálek Z.: Predicting the time of morning departure from winter communal roosts in Corvus frugilegus (Aves: Passeriformes) . . . . . 259
Hůrka K., Jedličková Z.: Carabidae (Coleoptera) dreier grossen Prager Stadtparks . . . . . . . . . . . . . . . . 9
Khalid A. M., Závěta J.: Changes of the coefficient of condition in the crucian carp (Carassius carassius, Pisces: Cyprinidae) . . . . . . . . 18
Khalid A. M., Závěta J.: Evaluation of the growth of the crucian carp (Carassius carassius, Pisces: Cyprinidae) in some localities in Czechoslovakia and Poland . . . . . . . . . . . . . . 164
Mlíkovský J.: Brain size in birds: 4. Passeriformes . . . . . . . 27
Mlíkovský J.: Foramen magnum in birds . . . . . . . . . 97
Moravec F., Baruš V.: Some nematode parasites from amphibians and reptiles from Zambia and Uganda . . . . . . . . . . . . . 177
Moravec F., Sey O.: Some nematode parasites of frogs from Papua New Guinea and Australia . . . . . . . . . . . . . . . 268
Papáček M., Štys P., Tonner M.: Ventrolateral thoracic region and thoracico-abdominal junction of some Helotrephidae (Heteroptera, Nepomorpha) . . . . . . . . . . . . . . . . . . 107
Patočka J.: Über die Puppen der mitteleuropäischen Depressaria und der benachbarten Gattungen (Lepidoptera, Oecophoridae) . . . . . . . 38
Porkert J.: Zu Bastardierunged in den Anstiegs- und Aussterbensphasen einiger mitteleuropäischen Populationen des Auerhuhns, Tetrao urogallus (Tetraonidae, Aves) . . . . . . . . . . . . . . . . 56
Šorič V.: Salmonids in the Ohrid-Drim-Skadar system . . . . . . . 305
Tenora F., Hönigová M., Shalayeva N.: Anoplocephaloides cf. lemmi (Cestoda), parasite of rodents of the genus Lemmus in the USSR . 193
Tenora F., Shalayeva N.: Scanning electron microscopy of Ascaris tarbagan (Nematoda) . . . . . . . . . . . . . . . 130
Velebný M., Závěta J.: The growth of the fry of the roach (Rutilus rutilus) and the bleak (Alburnus alburnus) in the Orlík valley water reservoir in 1983 . . . . . . . . . . . . . . . . . . 69
Vorobyeva E. J., Rubzov V. V., Markov K. P., Baruš V.: Ultrastructural studies of fish egg membrane . . . . . . . . . . 198
Zajonc I.: Earthworms (Oligochaeta, Lumbricidae) from the High Tatras . 201
Závěta J.: Mortality and rate of survival of the bream (Abramis brama) in the Orlík riverine lake between 1980—1983 (Pisces) . 220

**Zelenková J., Hůrka K.**: Carabids (Col., Carabidae) in the epigeon of pest management apple orchards in South Bohemia . . . . . . . . 133
**Zima J., Lukš D., Macholán M.**: Unusual karyotypes in Apodemus cf. flavicollis and Microtus agrestis (Mammalia, Rodentia) . . . . . . . 146
**Živkov M., Jankov J.**: On the growth rate of brown trout (Salmo trutta m. fario) in some Bulgarian rivers and methods for its study . . . . . . 150

Short note: **Mamkayev Yu. V.**: The morphology of Turbellaria and the formation of the anatomical and histological systems of Metazoa . . . 227

Abstracts of papers presented at the 19th conference of the Protozoological section of the Czechoslovak Zoological Society . . . . . . . . . . . 230

Reviews . . . . . . . . . . . . . . . . . . . . . 80, 239, 319

**Data of offearance of the numbers**

1. 20 February, 1990
2. 20 May, 1990
3. 20 October, 1990
4. 20 December, 1990

## INSTRUCTIONS TO AUTHORS

*Acta Societatis Zoologicae Bohemoslovacae* publishes, in major languages, original papers on general, applied and systematic zoology, biographies and book reviews. Papers by members of the Czechoslovak Zoological Society are preferred. It is understood that manuscripts submitted are not offered to any other journal for *prior or simultaneous publication.*

Authors of taxonomic papers must respect the articles of the International Code of Zoological Nomenclature (Third Edition, 1985) and to observe its recommen*dations.*

The manuscript, including footnotes, references and tables, must be typed with double spacing (30 lines per page), in duplicate, and should not be longer than 30 pages. *Pages must be numbered throughout the entire manuscript.*

### Formal arrangements

Heading. Title of the paper, full name of author, place of work with full address — each on separate line.

Abstract in English, summarizing concisely the contents of the paper and indicating the relevance of the work, should not exceed 20 type-written lines.

References (not bibliography): Authors should be cited in the alphabetical order with the papers of individual authors arranged chronologically. The titles of papers should be cited in full, followed by abbreviations of periodicals in accordance with the World List of Scientific Periodicals, 4th edition, Butterworths, London (*1964—1965*). Examples, papers: Dryden G. L. *1968*: Growth and development of Suncus murinus on Guam. *J. Mammal.*, 49: 51—62, the number is to be given (in brackets) only when individual numbers are paged independently. Books: Lattin *G. de 1967: Grundriss der Zoogeographie. 602 pp, Fischer, Jena.* Cyrillic alphabet should be transferred in Latin after ISO Recommendation R 9, International system for the transliteration of Cyrillic character 1. Ed. October 1955 or by Zekalle R *1964: **Pedologia,** 4: 88—91, Jena.*

Illustrations and their caption or legends must form a separate unit. Clear technically perfect line drawings and photographs (black-white, glossy) are accepted. The original drawings and photographs (one set) should be not more than twice as large as when printed and preferrably arranged into blocks or plates so that the blocks of drawings or photographs may be uniformly reproduced over the page-width of the journal. Legends to the illustrations should be supplied on a separate sheet of paper.

Tables including headings and explanations should be on separate sheets of paper, numbered consecutively with Arabic numerals.

Marking in the manuscript (in light pencil, not in ink or type-written) *In the text: Latin names of taxa up to the generic level — with wavy underlining* (italics); the names of authors cited and authors of taxa and any word to be printed spaced — with dashed-line underlining. In the References: names of authors with *dashed-line, names of periodicals (not the Latin names of taxa) with wavy under-lining.*

Reprints: 100 reprints are supplied free.

Address of the Executive Editor: Dr. Karel Absolon, Viničná 7, 128 44 Praha 2, Czechoslovakia.